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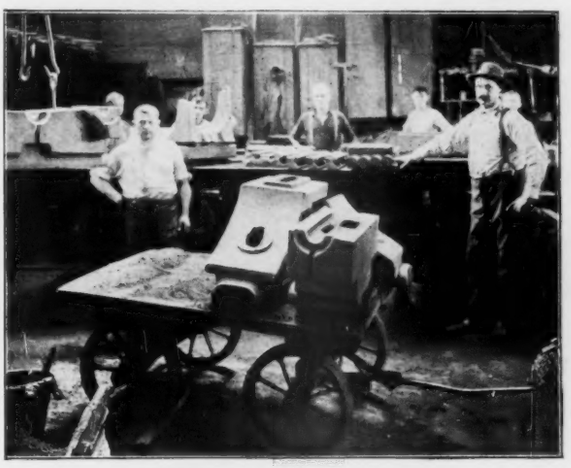

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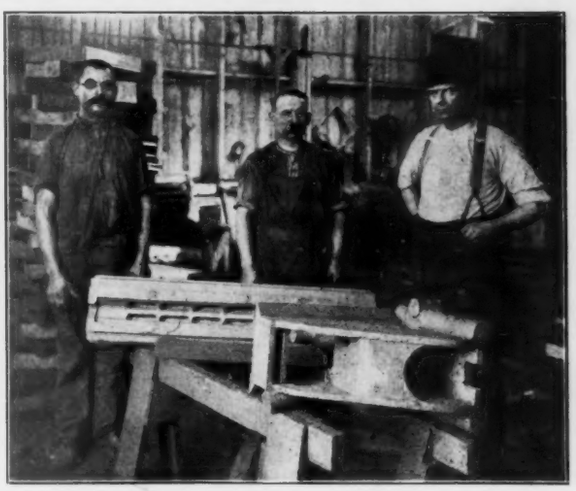

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THE FOUNDRY

Vol. 31, No. 1 CLEVELAND, OHIO, SEPTEMBER, 1907 Whole No. 181

A CHAT WITH OUR READERS

TO COMMEMORATE the sixteenth anniversary of THE FOUNDRY, we have changed it from magazine to standard size, 9 x 12 inches. This radical departure has been carefully considered for several years, and as the September number is the first issue of Volume XXXI, we concluded that this was the time to make the change. Otherwise, it would have been postponed six months and perhaps a year.

We realize that our subscribers, many of whom have been readers since the first issue, have grown accustomed to THE FOUNDRY in the form in which it appeared during the last 15 years. Some of our advertisers likewise argued against this move. These objections and others were given serious thought.

On the other hand, the foundry industry has outgrown the magazine size for a publication devoted exclusively to its interests. This is an era of expansion, and we believe by taking this action we are only keeping pace with the trade whose development in recent years is unparalleled.

Nor are we establishing a precedent. Some of our leading technical societies have adopted resolutions favoring a 9 x 12-inch page. The foremost technical and trade publications have adopted this size, and two other periodicals published by this company were standardized two years ago when the increase in the page area of THE FOUNDRY was first considered.

Furthermore, many of our advertisers have been compelled to prepare special copy and engravings for THE FOUNDRY, as those used in other journals would not fit its columns. This not only incurred additional expense, but caused delay and involved mechanical operations in our printing plant.

Larger illustrations can also be used in the editorial pages, and views of plants, machinery, drawings, etc., can be reproduced to better advantage.

To us, the arguments in favor of the change outweighed those that were, and might be advanced against it.

As in the past, THE FOUNDRY will serve all branches of the foundry and patternmaking trades.

Every effort will be made to improve the reading pages and no expense will be spared.

The matter, as heretofore, will be carefully selected, both as to quality and variety.

Our corps of special contributors is constantly increasing, and now covers every iron center in the world.

During the past six months many innovations have been introduced in the columns of THE FOUNDRY, and others, equally valuable and pleasing, are in store for its readers.

Just one word regarding our growth in this period. From February to August we published 544 reading pages, as compared with 454 during the previous half year. This was an increase of 90 pages, or an average of 15 each issue.

AN AIR COOLED GAS ENGINE CYLINDER

Methods of Molding and Patternmaking—Light Weight of Automobile Castings Presents New Problems to Foundrymen

BY E. F. LAKE

THE air cooled gas engine is almost entirely an American product, having been developed and brought to its present state of perfection by American engineers and American inventive ability. In this it differs from the water cooled gas engine which was brought out and developed almost entirely in Europe, the engineers and mechanics on this side of the big pond merely copying the ideas and principles which were perfected on the other side. In order to judge which of the many methods adopted is the best way of molding the air cooled cylinder it will be a great aid to the molder to know where the cylinders are to be used, the work which each part does, and the strains which are put upon them, as then he can tell where it is possible to use chaplets, where the best iron is needed in the casting, the quality of iron it is necessary to have in pouring, the kind of sand to use in molds and cores, how hard to ram the mold, and many other details which are almost too numerous to mention.

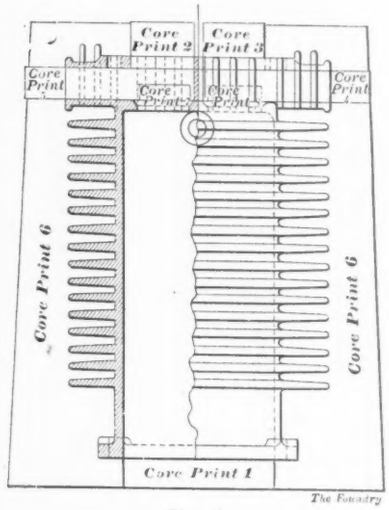

FIG. 1

Air Cooled Engine.

In the adoption of the gas engine for automobile use, a demand has come from the users for something that can be run in cold weather without a danger of its freezing and bursting pipes, cylinders, radiators, etc., and for this reason many manufacturers of automobiles have experimented with and decided to use the air cooled engine. Another place where it is liable to be used more in the future than it is at present is on motor trucks, as these must be operated in all kinds of weather and must be as simple as possible in construction. As the air cooled engine does away with the water system with its radiator, pump and numerous pipes, it seems to be an improvement over the water-cooled engine for that purpose.

Cylinder Design.

In designing the gas engine cylinder, one of the first problems that confronts the engineer is to get the heat out and away from it as fast as it is created by the explosion of the gas on the inside. Before giving the various ways which have been used to carry away this heat, it will be well to say that it is done by radiation and convection. Radiation means to send out in straight lines and in this case it means to radiate or send out in straight lines the heat from the center of the cylinder. This can only be done by having some heat carrying substance to radiate it through, and much time has been spent in experimenting on the depth, taper, thickness, and spacing of flanges, pins, ribs, wire coils, etc., and the use of different metals for these radiating surfaces. This is the same problem in kind, although it may not be in degree, which has been and is being worked out by the manufacturers of finned tubular radiators. The heat is therefore radiated by some radiating substances from the center of the cylinder to the outside edge, and thus far radiation could not be dispensed with; but if convection were not brought into use the heat would stay on the outer edge and back up into the cylinder, making it too hot to use. This has been amply demonstrated in experimenting, by engines running idle without any means of conveying the heat away and it was only a short time before they became too hot and back-fired or had premature explosions by the heat of the cylinder lighting the gas before the piston came to the top of its stroke, thereby stalling the engine.

Radiation.

Therefore convection is brought in to aid radiation, by the use of a fan which blows a current of air against the cylinders, and the molecules of air absorb the heat and carry it away. It is like wiping sweat off a pane of glass with a handful of waste.

Numerous ways have been devised for radiating surfaces on the air cooled cylinders. One form is to cast the cylinder plain, drill and tap numerous holes all around it and screw in tapered pins which have been threaded on one end. This makes the cylinder look like a porcupine when in action. Another way is to use the same plain casting and screw tubes in the side which have been slotted so the heat can be conveyed away easily. Another variation of this is to screw wire spirals in the casting. This makes it look like a spring bed which has been rolled up. With all of these methods, however, a slight film is liable to form between the cylinder and the pieces screwed in and hinders, or reduces radiation.

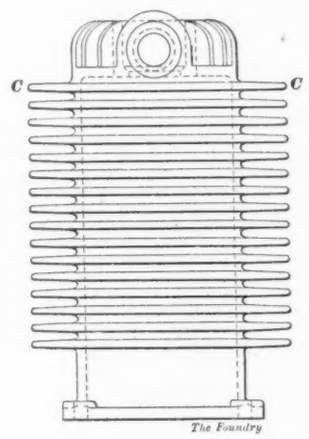

FIG. 2

Another way is to use the plain cylinder casting, cut dovetail grooves lengthwise of the cylinder

and insert copper fins with comblike teeth, as illustrated by Fig. 4, in these grooves. With this, however, as with the forms described above, the cylinder casting would have to have thicker walls than would otherwise be necessary in order to cut the grooves and drill the holes in them. If the cylinder were broken through it might cause a leak when the explosion of gas took place, which would result in a loss of power, besides being harder to cool.

Another Method.

Another method which has been used is to take a square sectioned copper wire, wind it over a form of triangular shape with two long sides and a flat base, as if making a long spiral spring. Inside of this spiral is run a flat copper ribbon and the whole wrapped around the plain cylinder casting, the copper ribbon pressing the flat base of the spiral against the sides of the casting. This was then given a heavy copper plating to close the openings between the cylinders and the spiral so that the radiation would not be interrupted.

All of the above forms, however, are expensive to build and give no better results than to have flanges or pins cast integral with the cylinder. This makes more work for the molder and coremaker but it saves all the machine work which is necessary on the above styles and which is quite a large item.

Cylinder Generally Adopted.

The flanges running around the cylinder and cast integral with it, as

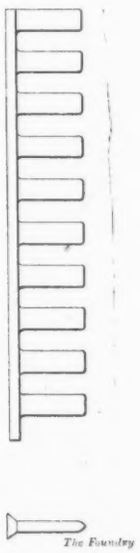

FIG. 4

illustrated by Figs. 1, 2 and 6, is the style that has been adopted by most of the manufacturers of air-cooled

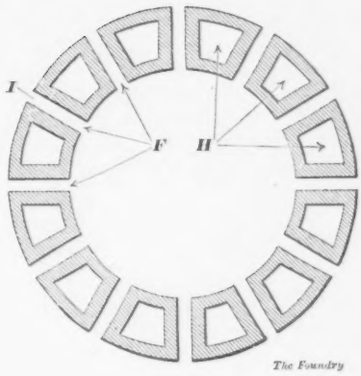

FIG. 3

motors and this is being used successfully in larger sizes every year. Where a few years ago two or three horsepower per cylinder was considered the limit for air-cooled gas engines, they are now being made ten-horsepower per cylinder and the limit has not yet been reached.

Design of the Air-Cooled Cylinder.

In designing, building the pattern and core-boxes, making and setting the cores and in making the mold great care must be taken and close work done so as to have a uniformity of metal. If the metal is thicker on

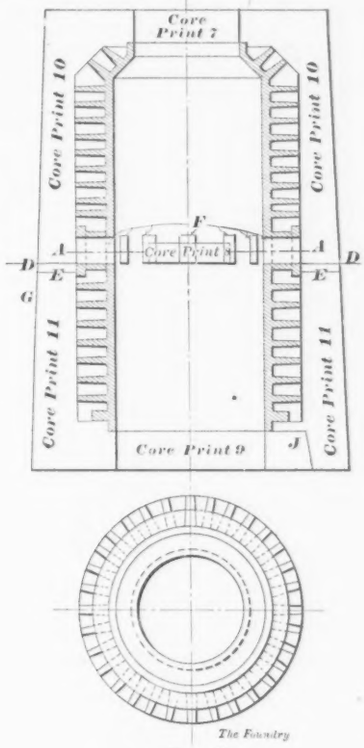

FIG. 5

one side than on the other, or if the core tips so as to make it thicker at the top than it is at the bottom, the heat will not radiate away from one part of the cylinder as quickly as it does from another part and may therefore cause the cylinder to become deformed. This would mean that the cylinder would have to be rebored and the piston rings refitted. When one realizes that the temperature in the compression chamber, on explosion, is from 2,200 degrees to 2,600 degrees Fahr., and that the mean temperature of the cylinder wall must be kept at about 350 degrees Fahr. to get the best results from the engine, one can see how a variation in the thickness of metal will affect the cylinder when it is supposed to be carrying its greatest load.

Method of Molding.

The flanged cylinder, as shown in Figs. 1, 2 and 6 could be parted on the line B B, Fig. 6, and molded on its side in green sand. The core could be made in one piece and located in core prints 1, 2, 3, 4 and 5, but if molded in this way it would be difficult to get the flanges cast, especially on the cope side, as they are usually but 3-32 of an inch thick on the outer edge and there are many of them, as they are placed quite close together. Thus, if air pockets formed in the cope and the iron failed to rise in the flange, it would mean ragged castings which would have to be scrapped. Then, again, the iron would not be as good on the cope side, owing to gas bubbles, facings washing off, or loose sand, unless a riser was used on each flange or one riser the entire length of the casting and this would mean more work for the molder as well as a good deal of work to saw off the riser and file each flange so as to make them conform to the rest of the diameter.

An Improved Method of Molding.

A better way of making this would be to build the pattern in a core box, as shown by core print 6, Fig. 1. Each flange would then form as the iron

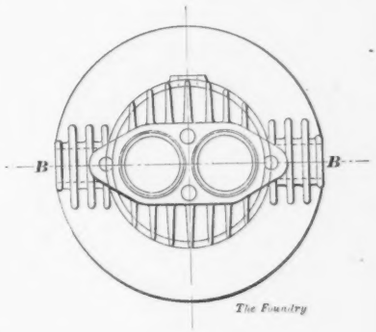

FIG. 6

rose in the mold and if the top of the mold, which would be at core print 1, was of poorer iron than the

bottom, it would not make so much difference, as this end of the cylinder is always covered by the piston and there is no strain on it from the explosion of the gases, and no heat except what little radiates from the other end, as most of the heat is conveyed away before it reaches that far.

Center Core.

The center core could be made in three parts. That which forms the inlet passage for the gas at core print 5, and the opening to insert the valve at core print 2, would be made in one core, which would be located in these prints. That which forms the exhaust passage at core print 4 and the opening for the insertion of the exhaust valve at core print 3 would make the second core, and this would be located in core prints 3 and 4. Then the barrel core would form the third one. This could be located in core prints 7 and 8, which are at the valve openings and which are formed in the inlet and exhaust passage cores. It would be held in place in the cope by core print 1. By making the mold of dry core sand they could be heated in the core oven before pouring, which would insure a much better casting.

Copper Flanges.

One of the largest automobile manufacturers in the country, using air cooled cylinders, is this year using copper flanges and casting an iron cylinder to them. This can be done by casting each copper flange separate and building up the mold by first molding the head up to the line C C, Fig. 2, and then putting in a copper flange, which is placed next to a barrel to form the center of the mold and to hold the flanges in position, then by placing a core in the mold to form the space between the flanges and alternating with a copper flange and then a core until it is built up to the top.

When the molds are ready to pour they are heated in an oven to a temperature sufficient to make the copper flanges fuse with the molten iron when it is poured in the mold. One manufacturer used aluminum instead of copper flanges in making an air cooled cylinder of this style. Brass flanges have also been used.

The copper flanges are used for two reasons. One is that the heat is absorbed from copper by the air, quicker than it is from iron, and the other reason is that the copper flanges will not chip and break off as iron flanges do. It is a question, however, whether the copper flanges will ever come into general use, owing to the added cost of the copper over iron and the extra work in molding and coremaking that is required to produce this style of cylinder. Then again, unless the copper and iron are fused perfectly, the heat will not radiate as well as with the iron flange and iron cylinder cast integral.

Two Cycle Engine.

In Figs. 3 and 5, I have illustrated a cylinder with tapered pins cast integral and in this cylinder I have used the two-cycle principle. The two-cycle engine is very seldom air cooled. In this case a sheet metal case was put on over the pins and a current of air blown around the pins between this case and the cylinder wall. The explosions come twice as often in a two-cycle as in the four-cycle engine and it is therefore harder to cool, but special designs are being brought out to overcome this difficulty, and we may in the near future see as many of them air cooled as of the four-cycle type. The taper pins, however, are used nearly as much as the flanges for cooling purposes and the problems presented here for the molder and patternmaker can be applied to the four-cycle cylinder shown by Fig. 1 as well as to the one shown by Fig. 5.

The cylinder, with tapered pins for cooling, as shown by Figs. 3 and 5, is, no doubt, best made by building the pattern in a core box and then molding it with the top of the cylinder down, in order to insure the best iron in this part of the casting. This being a two-cycle cylinder, there is a row of portholes, F, Figs. 3 and 5, around it where they will be uncovered by the piston when at the lowest point of its down stroke. In order to get these port holes in it is best to part the center core on the line D D, Fig. 5. The center core and port hole cores can then be made in one piece. This cylinder being covered with a sheet metal jacket G, Fig. 5, and a current of air being blown around the pins between that and the cylinder wall to carry away the heat, it is necessary to have a series of holes between the ports as shown at H, Fig. 3, to allow the current of air to pass from the lower to the upper half of the cylinder. These can be put in by parting the outside core on the line E E, Fig. 5, as then the cores that form these holes can be made in one piece with the outside core, that is located in core print 10. The pattern in the core box is best made by making a barrel smaller in diameter than the outside of the cylinder, and then putting staves on it to which are fastened the tapered pins. Then, when the core is rammed and the sand tucked in around the pins, the center barrel is drawn out and the staves, with the pins on, drawn in to the center opening left by the barrel and then out.

Setting the Cores.

The cores are then set, first, by placing the upper half of the outside core in core print 10, Fig. 5, which is in the nowel of the mold; second, by lowering the upper half of the center core, with which is made the port cores F, into core print 7, which has been formed in the outer core. This is held from tipping by the port cores having a bearing on the outside core at Fig. 3. The lower half of the center core can then be placed in position by locating in core print 8, Fig. 5, which has been formed in the upper half of the center core, and the lower half of the outside core is located in core print 11. This closes down over the center core at core print 9 and binds all of the cores firmly together so there is no danger of their slipping or washing out of place when the metal is poured in.

The two cores, forming the lower half, which are located in core prints 8, 9 and 11, which would be the upper half of the mold, could be set by first setting the outside core in core print 11, and then setting the center core in core print 8 and core print 9. If this were done it would be better to make an overhang print out of core print 9, as shown by the line J, Fig. 5.

New Problems.

Owing to the light weight demanded in these castings for automobile use, it has brought many new problems to the foundrymen, both as to methods of molding and the quality of iron used. Where, a few years ago, it was considered bad practice to make the walls of the cylinder less than ⅜ of an inch, we find today that the rule is 3-16 of an inch, and in racing cars and the smallest sizes of cylinders, ⅛ and 1-10 of an inch have been used for all the walls except around the compression chamber, and this has been made from 3-16 to ¼ of an inch thick, with ribs used to strengthen it. This, of course means that the very best iron obtainable must be used in these castings, and only in the last year one of the largest automobile manufacturers sent to France for all of his cylinder castings. There is no good reason for this now, as there are a num-

ber of foundries in this country that are turning out just as good castings as any abroad, both as to the texture and strength of the metals. From some castings that I saw at the automobile show held in Grand Central Palace, New York, Dec. 1-8, 1906, those exhibited by the American foundries had a much better finish and outside appearance than any from France or the other countries in Europe.

Quality of Iron.

The quality of the iron demanded for these cylinders has caused the foundrymen to adopt new formulas, new methods of melting and new ways of pouring the metal. The best results seem to come from those who have installed the reverberatory or air furnaces, in place of the old cupola. One of the large automobile manufacturers has adopted the following formula for his cylinder castings:

	Per cent.
Graphitic carbon	2.80
Combined carbon	0.58
Silicon	1.78
Manganese	0.44
Sulphur	1.75
Phosphorus	....

These cylinders are ¼ inch thick over the compression chamber and have to stand a compression strain of 68 pounds.

The advent of the automobile has brought many improvements to the gas engine, as it is used for a large number of purposes, such as farm work, lighting plants in small buildings, power for small shops, etc. Where, ten years ago, there were very few used, today one can hardly find a town of any size in the country that does not have one or more foundries working on this class of work.

ACID OPEN HEARTH SLAG

BY W. M. CARR

IN AN acid lined steel melting furnace, one in which the hearth is formed by refractory silica sand, the only elements in the melting stock affected by the action of the slag formed are the manganese, silicon and carbon. The foregoing are not regarded as impurities. The impurities, phosphorus and sulphur are not subject to removal by such a slag.

At the end of the conversion period, the quanties of manganese and silicon originally present will be reduced to traces, and the original amount of carbon in the bath of metal may be removed to a point that it is deemed necessary to tap the furnace.

The amount of phosphorus remaining at the same period will equal the quantity carried in with the melting stock plus that yielded by additions of iron ore made during the progress of conversion. It will be slightly increased in percentage because of loss of metal in melting. In other words there will be under normal conditions of practice, less metal taken out of the furnace than was charged. The difference or loss being due to an unavoidable burning or oxidation of the stock. Since there is no absorption of phosphorus by the silicious slag, the gain in the element in question in the finished material over the amount charged will be in keeping with the loss in metal.

For the same reasons there will be a gain in sulphur in the finished material over the raw, in varying quantities, also depending upon the character of fuel used and the speed in melting. In the United States, producer gas made from bituminous coal carries more or less sulphur. The flame from such a gas passing over a charge of metal being treated in an acid lined furnace, gives up some of its sulphur to the metal while it is melting, but as soon as the mass becomes liquid and passes below the covering slag, there is no further contamination by the flame, nor removal of sulphur by slag action. The greater the quantity of sulphur in the fuel, the greater the time of exposure to flame before complete fusion, the greater will be the absorption of the element in question.

Manganese, silicon and carbon usually present in varying quantities in acid melting stock, charged in a Siemens or open-hearth furnace, yield to an oxidizing influence partly by reason of the flame and partly by the slag. The first two elements known as a metal and metalloid respectively, become changed to their several oxides and finally enter the slag as combined silicates and unite with whatever oxide of iron may have formed through the effect of flame action previously described. The carbon, also a metalloid, submits to a similar oxidizing action at different stages of conversion, but instead of entering the slag as a solid oxide, passes away as a gas and mingles with the products of combustion from the fuel. In the exit of the gaseous carbon there will be more or less agitation of the bath by bubbles formed by the reaction between the solid carbon in the metal and the ferrous oxide dissolved in it and that of the slag.

The composition of an acid slag is made up from sand adhering to the cold melting stock, hearth scorification, oxidation of the manganese and silicon present in the charge and oxidation of iron by flame action as described.

The volume of the slag will vary with the character of the charge, the nature of the fuel, the necessary additions of iron ore and the manipulation of the heat. It is regarded as a ferrous silicate and consists of nearly equal parts of silica and ferrous oxide. Should manganese be present in the stock, its resultant oxide will replace some of the ferrous oxide but the sum of the two oxides will nearly equal that of the silica.

As the period of melting and conversion proceeds the volume of the slag will increase, but under normal conditions, the relative amounts of acid (silica) and bases (iron and manganese oxides) will be fairly constant throughout the progress of the heat. The adjustments are self-regulated and the maximum volume of slag is reached at the end of charge conversion. There may be near the end of the operation a decrease in the percentage of manganese oxide in the slag by an increase in the iron oxide brought about by additions of iron ore without materially changing the ratio between the acid and bases. With normal conditions the fluidity of the slag and its requisite composition is practically automatic and it is unusual that an acid open-hearth slag should need readjustments by outside agencies.

A FOUNDRY FOR LOGGING MACHINERY CASTINGS

Plant of the Prescott Co., Menominee, Mich., Equipped with a Tilting Open-Hearth Steel Furnace

THE increasing use of steel castings as a substitute for gray iron in heavy duty machinery, has been marked by development of the best machinery practice of recent years. The Prescott Co., Menominee, Mich., manufactures a wide line of saw mill and logging machinery, a class of equipment generally receiving extremely hard service and whose distribution invariably is over thinly populated districts. The desirability of having castings in machinery of this character that would insure against the shocks and strains incident to cutting logs into lumber for the market is evident. The company, alert to meet the demands of its trade, found it difficult to secure steel castings of satisfactory quality, and was further harassed by slow deliveries. To remove these objections and to insure a uniformly reliable product for its requirements, it decided to go into the casting of steel for itself.

Flexibility of operation was a paramount requirement in determining the type and capacity of the furnace to be installed, and investigation was made of a number of plants before a decision was reached. Eventually, the 5-ton basic, open-hearth, tilting furnace, using crude oil for fuel, manufactured by the Wellman-Seaver-Morgan Co., Cleveland, was decided upon, and a plant of this kind has been installed and is now in operation. It is the only basic open-hearth foundry in the upper peninsula of Michigan. The furnace has a capacity of 25 tons daily, and the foundry is equipped to produce castings ranging from 15,000-pound pieces downwards. A heat can be poured every four hours at an expense of 45 gallons of oil per ton of steel produced. Elastic in operation, the furnace has proven to possess the additional good features of being economical and clean. There is almost a total absence of gas, smoke, cinders and dirt usually attendant upon foundry operations, and working conditions are always highly satisfactory.

The furnace, located in the southeast end of the building, on the side adjoining the stockyard, is 31 feet over all by 8 feet in diameter. The hearth is 16 feet long by 5 feet 9½ inches wide. The post ends are 7 feet 7½ inches wide by 5 feet 10½ inches long. The regenerative chambers are 6 feet wide, 12 feet long and 10 feet 3 inches high. The regenerative chambers are enclosed in a sheet steel shell binding, said to be a great improvement in preserving the life of the brick over the ordinary I-beam and buckstay binding, more commonly used. The flues are provided with a Foster patented water seal reversing valve, operated by hydraulic pressure. The spout is 6 feet long. Two solid concrete abutments support the furnace, their foundations being 5 feet below the floor line. At this level, 10 inches of concrete have been laid to prevent the seepage of water into the floor of the foundations. The furnace is tilted by hydraulic pressure, and has a tilting piston 49 inches between high level and low level. It moves on roller bearing rollers, these provided to allow easy opera-

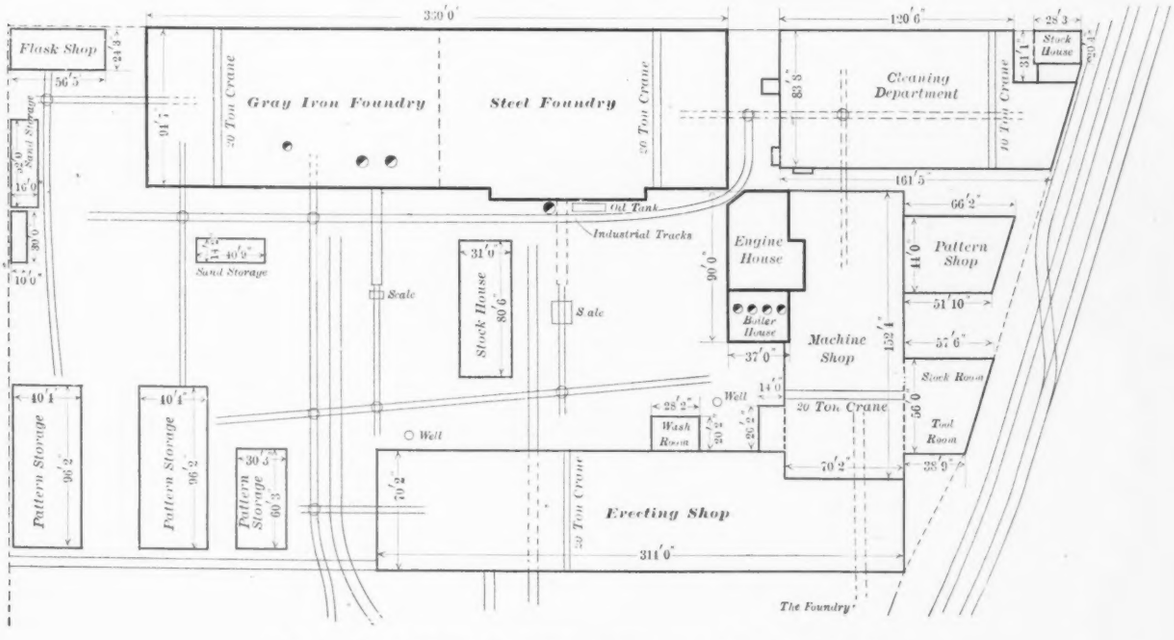

FIG. 1.—PLAN OF THE PRESCOTT CO.'S PLANT, MENOMINEE, MICH.

FIG. 2—INTERIOR VIEW OF THE STEEL FOUNDRY

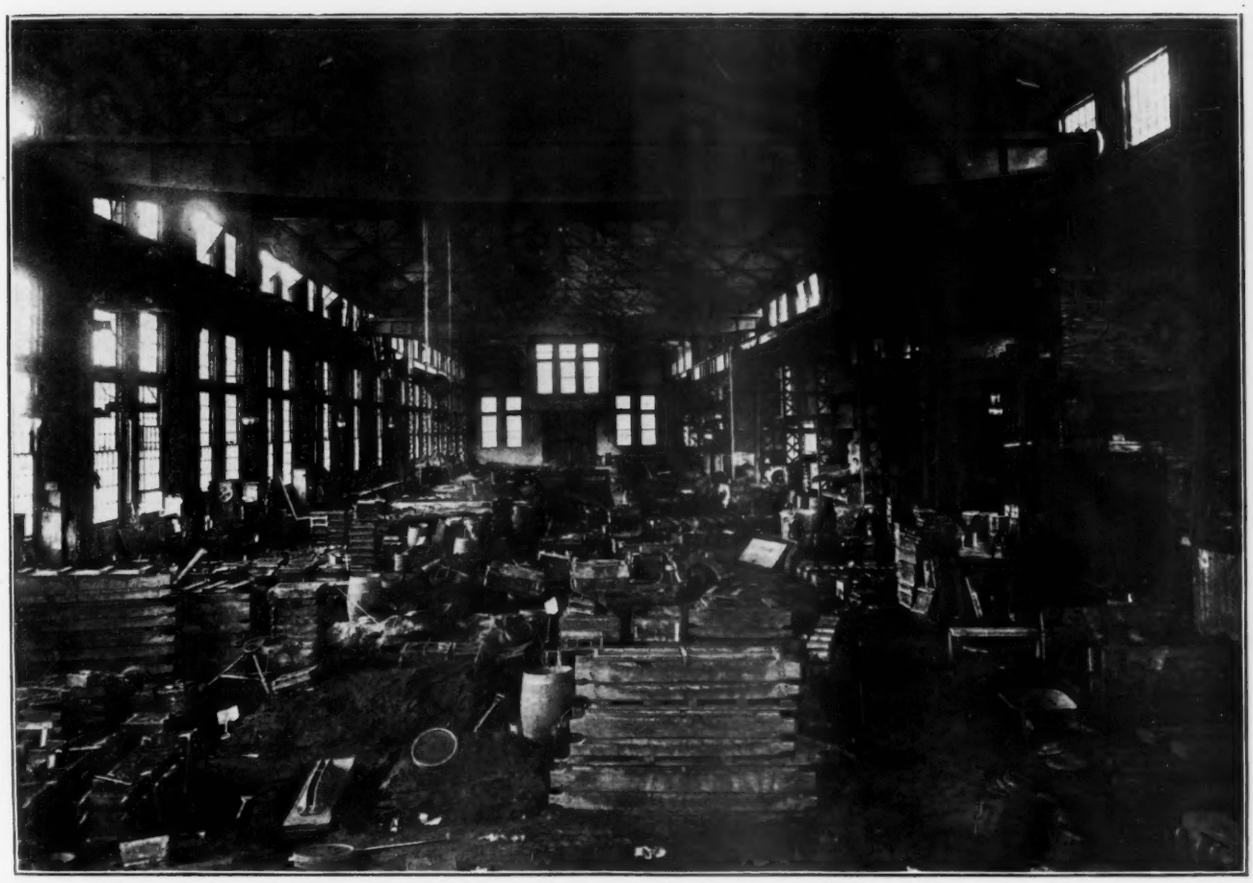

FIG. 3—INTERIOR VIEW OF THE GRAY IRON FOUNDRY

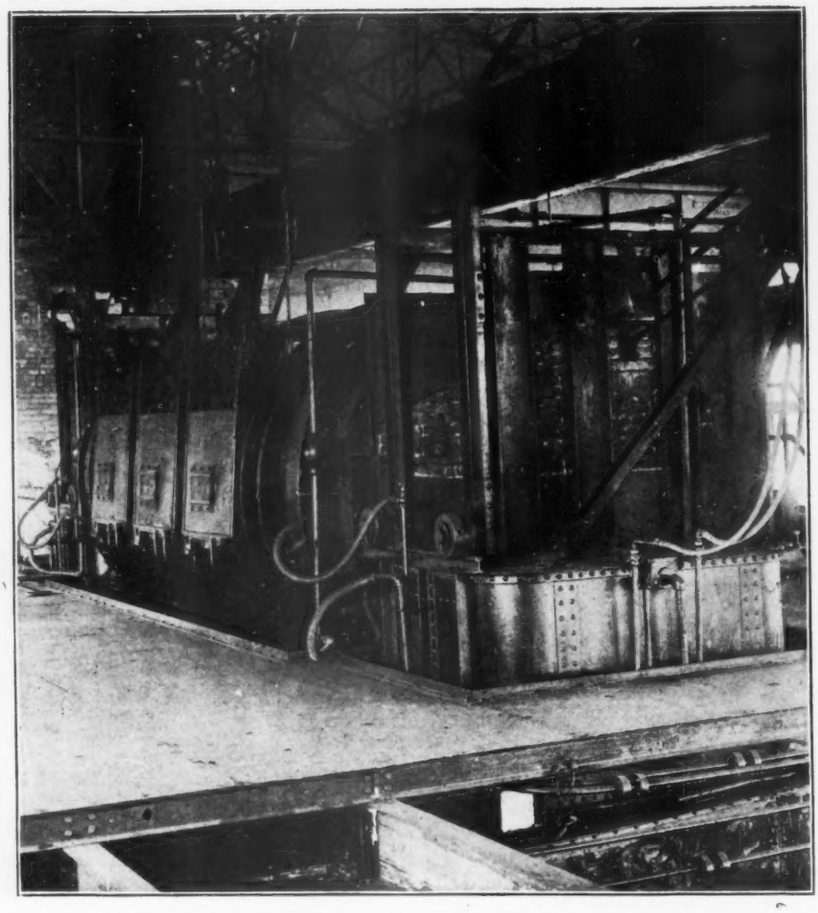

FIG. 4.—CHARGING SIDE OF OPEN-HEARTH TILTING FURNACE

tion and to prevent the lining from jarring loose. The pump supplying the pressure was furnished by the Platt Iron Works, Dayton, O. Its controlling valves are located at one end of the tapping platform, within easy reach of the operator. The charging platform is 12 feet above the floor line; 28 feet wide, and 50 feet long. The tapping platform is 3 feet above the charging platform. The furnace is hand charged, but it is proposed to put in a charging machine when the second furnace is installed, provision for which was made when the present plant was designed. An important feature of the furnace is the removable port ends, which allows the use of a spare end which may be bricked up and rolled into place as soon as the burnt out end is removed, thus causing a minimum amount of delay.

Compressed air is the atomizing agent of the oil. Vaporization is accomplished in a chamber at the end of the feed line, a 700-cubic foot Ingersoll-Rand compressor supplying the blast. The oil is entered and heated in a No. 3 double pumping system, installed by the National Supply Co., Chicago, before delivery to the reversing valves. This apparatus is designed to automatically pump and deliver any quantity of filtered oil within its capacity under uniform pressure and temperature. It consists of a battery of duplex steam pumps, specially brass fitted for oil, and a cast iron receiver tested to 200 pounds hydrostatic pressure. A partition divides the receiver into two compartments or chambers. Projecting into the rear chamber and screwed to the partition are tubes with fine gauze heads, accessible through the rear head of the receiver. These heads act as a filtering or straining medium, and the compartment is provided with blow-off pipe and valve for removing any sediment or extraneous matter deposited therein. The forward chamber, usually carried two-thirds full of water, contains a coil of pipe through which live steam or exhaust steam from the operating pump flows. In action the oil is discharged through the pressure chamber of the pumps into the forward chamber. The oil flowing through the hot water becomes heated to about 200 degrees and passes out through an inner tube to the place of consumption. A cylindrical storage tank, of 12,000 gallons capacity, filled by gravity, is located outside and parallel with the building, the oil being drawn by suction from this tank into the circulating system. The burners are located at each end of the furnace and operated alternately.

Melting material is raised to the charging platform by an incline starting from the stockyard, the cars being hauled by an electrically operated cable. A scale is conveniently located at the foot of the incline, and as the buggies are filled they are elevated and placed in front of the furnace. By this arrangement the cost of hauling has been reduced to a minimum.

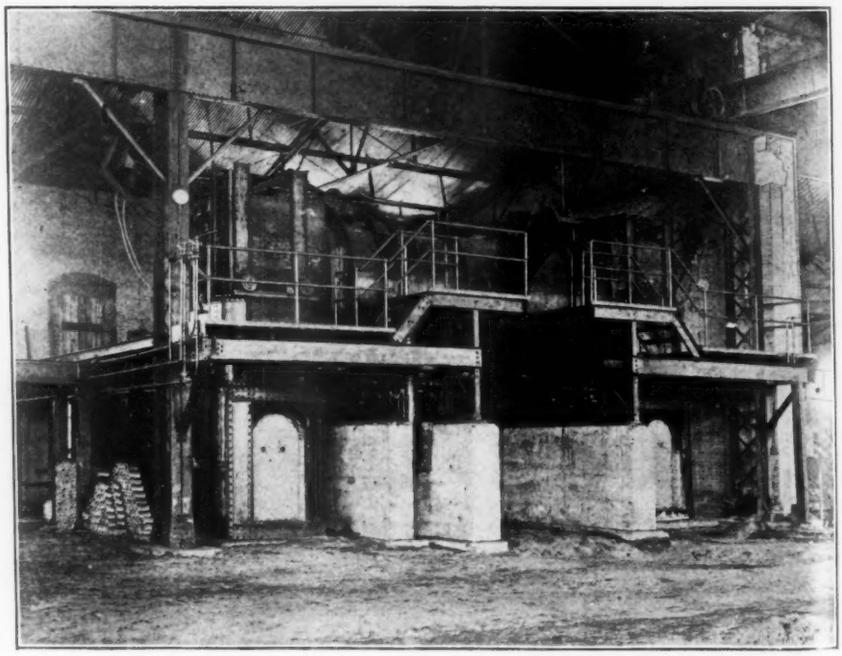

FIG. 5.—POURING SIDE OF OPEN-HEARTH TILTING FURNACE

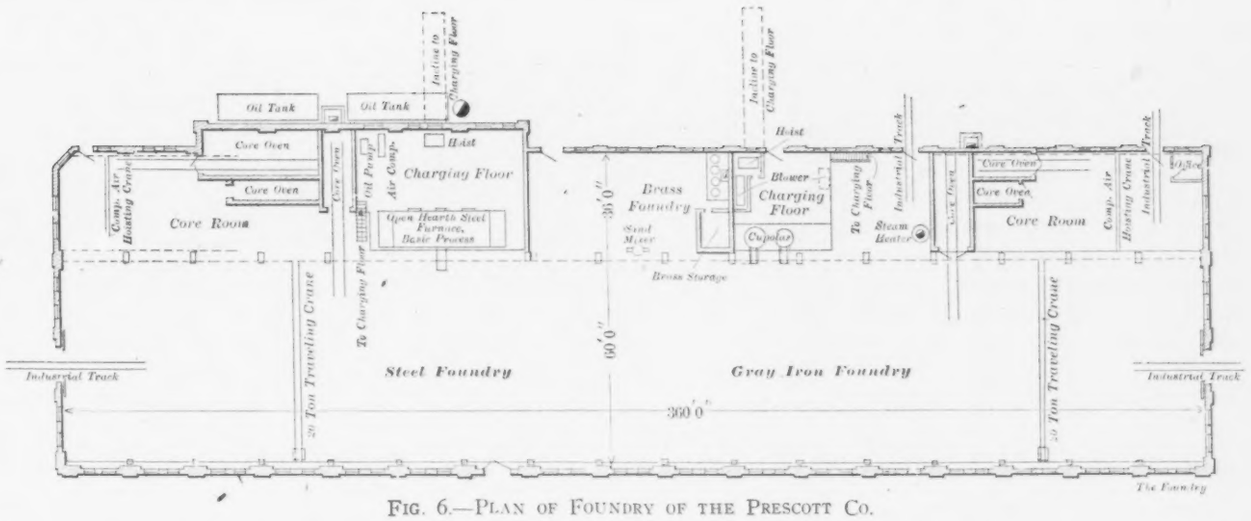

FIG. 6.—PLAN OF FOUNDRY OF THE PRESCOTT CO.

The steel foundry adjoins the gray iron foundry, the two departments comprising one building, under one roof, as shown in the ground plan and in the side elevation. The steel furnace and the two cupolas in the gray iron foundry, as well as the brass foundry and the core ovens for all departments, are located in the bay running the entire length of the building. The tapping side of the furnace and cupolas open into their respective molding floors, the latter being each 180 feet long by 62 feet wide, and separated by a brick wall a couple of feet high. The building is served by two 10-ton electric traveling cranes, built by Pawling & Harnischfeger, Milwaukee, one for each department. The crane runways extend the full length of the building, and if necessary the two cranes can be brought together to assist in the pouring of metal or in the removal of heavy castings, flasks, etc. Three wall hoists installed by the Quincy, Manchester & Sargent Co., Chicago, of 2,000 pounds capacity each, are used for handling flasks, molds and small work. A metal saw made by the same company is also used in the steel foundry.

An excellent feature of the building is the splendid ventilation and natural light afforded by its structure. The height from the molding floor to the peak of the roof is 48 feet, and to the roof trusses, 32 feet. The building is 360 feet long, and including the bay, is 94½ feet wide. The bay is 32 feet wide. Windows are spaced a few feet apart, the dimensions of those on the sides of the building being 16 x 5 feet; on the eaves, 6 x 5 feet; and on the ends, 10 x 5 and 16 x 5 feet.

Three core ovens have been provided for the steel foundry, two opening into the core room and one into the foundry. All are heated with coke fires. The largest of the three opens into the foundry, and this is equipped with a truck 16 feet long by 5 feet wide. One of the remaining two is for medium-sized cores, and will accommodate a truck 12 feet long by 5 feet wide. The smallest oven is equipped with shelving and is used exclusively for small cores. The floor of the core-making room is laid with cement. Cores for the gray iron foundry are made at the opposite end of the building. One of the specialties in gray iron is a chilled roller for saw mill work, the chills and setting of cores being done with the aid of the Quincy, Manchester & Sargent air hoist, traveling on a hand crane spanning the bay. The same hoist is used to charge the core truck into the oven and to withdraw the same, this being done by attaching a snatch block to the truck end and the hoist. The gray iron core drying room has three compartments, one 14 x 9 feet; one 12 x 16 feet; and one 12 x 22 feet. The latter is served with a truck 14 feet long. A Wadsworth core machine is used in making small cores.

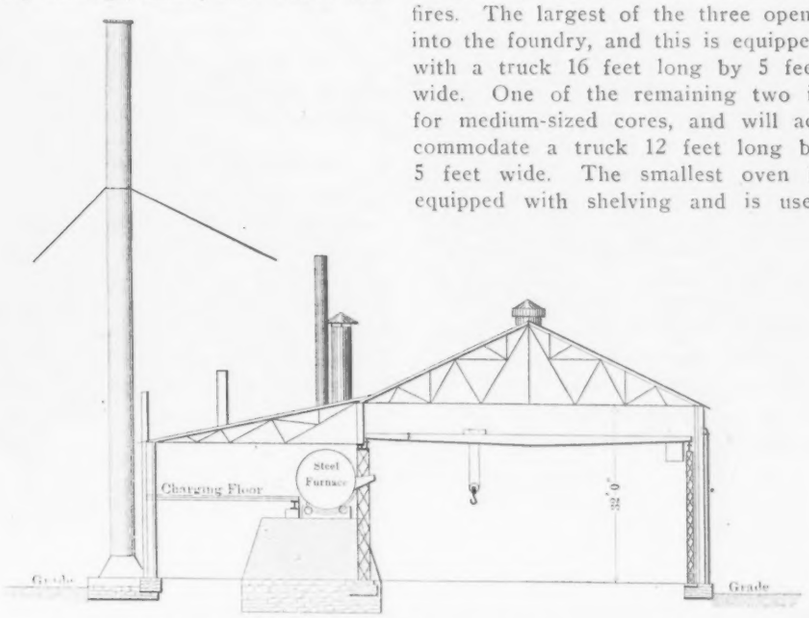

FIG. 7.—CROSS SECTION OF FOUNDRY OF THE PRESCOTT CO.

The cupolas are of Whiting make, one being of 25 tons capacity, and the other 15 tons. The charging platform is 16 feet above the molding floor, and, as in the case of the steel foundry, melting stock is elevated by means of an incline, operated by an electric cable. One of the unique uses to which this cable is put when not in use hauling cars, is to operate the weight of the drop in the stock-yard for breaking large pieces of metal. It is also used to unload scrap from railroad cars. All that is necessary is to connect the incline cable and the cable attached to the drop or the gripping tongs, with a snatch block. This novel arrangement saves two machines and greatly facilitates unloading of cars or the breaking of metal.

The blast for the large cupola is furnished by a No. 4 Root blower driven by a 20-horsepower Westinghouse motor; the smaller cupola is supplied with air by a No. 4 fan located on a platform suspended from

the charging floor. The molding floor in the gray iron foundry is served with two Hanna shakers, two rock-over Tabor machines, and one power Tabor machine. Two 5-ton bottom pour ladles are used in the steel foundry, and in the gray iron department are two 5-ton ladles; one of 6,000 pounds capacity; one of 4,000 pounds and one of 3,500 pounds capacity. The entire building is heated by steam from a vertical boiler located in the center of the bay. The brass foundry contains three crucible furnaces. When large brass castings are desired, the smaller cupola is invariably used.

The cleaning department is contained in a building adjoining the foundry. It is 160 feet long by 84 feet wide, and is connected with the foundry by an industrial track. Castings are deposited on the latter by the crane in the steel foundry, and in the cleaning room are handled by two steam jib cranes equipped with the Dake engine, made by the Dake Engine Co., Grand Haven, Mich. By the operation of a lever, the gears being so arranged, the crane will hoist slow or fast; the gears can also be locked by the same lever and the road remains stationary and perfectly safe. The same engine is used for running the rack in and out on the crane. The device is an idea of G. T. Cleary, the foundry superintendent. "Thor" pneumatic tools, made by the Independent Pneumatic Tool Co., Chicago, are used in this department.

An industrial track connects the machine shop and the cleaning room, and the machine shop is also connected with the erecting room by the same means. A 20-ton, 25-foot span Pawling & Harnischfeger traveling crane serves the machine shop in handling large castings. The machine shop is 152 feet long by 70 feet wide, and is served by a 20-ton Pawling & Harnischfeger crane, having a 38-foot span.

A PATTERNSHOP FOREMAN'S ADVICE

BY R. B. CLEVELAND

THE "don'ts" article which appeared in the August issue of THE FOUNDRY by the "Cleveland Club of Associated Pattern Maker Foremen" was amusing as well as instructive, and was read and appreciated by the patternmakers, molders, and quite a few of the machinists where the writer is employed.

Only a short time ago an issue of THE FOUNDRY was handed to me by the foreman molder and since that time I have been much interested in the success of the publication, doing a little missionary work among the patternmakers, molders, die makers and machinists, a duty, I, as well as every molder and patternmaker owes to the management of a paper that furnishes up-to-date matter pertaining to the patternshop and foundry trades. A molder can be a good mechanic yet not understand all about patternmaking. But a patternmaker who does not understand the general methods of molding, and more particularly up-to-date foundry practice, can never class himself among the "stars."

Seeking Information from the Molder.

When I was a young man it was common to see the patternmaker out in the foundry seeking information or assisting the molder in a complicated piece of molding or core setting. Not so today, much more is expected from him, the patternmaker is expected to produce a practical and mechanical job, and when it is so made the molder is supposed to be a mechanic and understand how to handle the pattern when he gets it.

The fact that running back and forth from the foundry to the patternshop is not tolerated in a number of establishments is, I think, a good reason why we should read and keep posted on modern ways and methods.

Looking at the "Don'ts" from a foreman's point of view, they are very good, now let us take the other side of a few of them.

The Other Side.

I contend that there are no hard and fast rules laid down governing the construction of patterns, and furthermore I can say without fear of contradiction that five or six blue prints may be given to as many men, the prints all being from one tracing, and no two men will construct the pattern in the same way. If each patternmaker, after receiving the blue print of a piece of work studies it well and after due consideration constructs the pattern according to the best of his mechanical knowledge, "he has done his best," and this is all that can be expected of him. If his "best" does not reach the standard of mechanics according to the ideas of the foreman then the foreman ought to do one of two things, either drop the man from the pay roll, or, when giving the man another job instruct him as to how it should be made. If this is done in a business-like way, the job is then up to the workman to make in a satisfactory manner.

First Suggestion

"Don't start your job until you have it well in mind, or you may strike a snag later on," is the first suggestion.

This "Don't" can be considered in a number of ways. A few years ago I worked in the patternshop of a large manufacturing concern in the east. The patternshop foreman was one of these small, mean, low, narrow-minded fellows who could never look you in the eye or give a civil answer. He handed a drawing to a workman with a grunt or sneer, and to ask him for any assistance that would enable you "To start your job right" was an insult. Yet this same man spent one-half of his time in the drawing room watching and having the drawings explained to him so that he could understand the details before the drawing was completed.

How easy "Don't" No. 1 would be for the workman if the foreman would sit with him and both go over the drawing, the foreman pointing out the parts not clear on the drawing, at the same time instructing the workman how he wanted the work done. Would this method not make "Don't" No. 1 easy and lessen the liability for errors?

"Snags."

Loosen up, some of you foremen, and help your brother craftsman "to start the job right." Today you are occupying the position of foreman, tomorrow you may be looking for a job side by side with the man, who, today you sneer at.

PATTERNS TO SUIT THE FOUNDRYMAN

Several Illustrations in Actual Shop Practice of the Good Results Attained by Pursuing this Course

BY OSCAR E. PERRIGO

IN THE pattern shop the assertion is only too frequently made that "we can't always be making patterns to suit the foundry man," and to a certain extent this is true. It is also true that it suit the foundryman," and to a certain maker who must use the pattern. It is up to him to produce a good casting from it, and while he is not "the court of last resort," he should surely be considered.

In the average manufacturing establishment, making its own patterns and castings, there is liable to be four separate and distinct influences and interests governing these matters which do not always agree, and whose disagreements cover minor matters of everyday occurrence frequently lead to many petty troubles, owing to the different viewpoints from which the heads of each of these departments look at a problem. These departments are the drafting room, the pattern shop, the iron foundry and the machine shop.

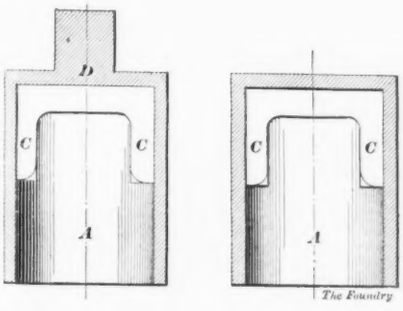

FIG. 1—GASOLINE ENGINE PISTON

Petty Differences.

The pattern shop quarrels with the drafting room because the drawings are not plain; they are dimensioned more for the benefit of the machine shop than the pattern shop; the pieces are of a much more complicated form than they ought to be; this piece ought to be forged instead of having a pattern made for it; or that one coud have been punched out just as well and much cheaper, and so on.

The drafting room hits back at the pattern shop with the implied suggestion that if the patternmakers knew their business they could read drawings of complicated pieces readily, and that it is the draftsmen's business and not that of the patternmakers to decide what the material of a piece shall be.

Then comes the iron foundry with the usual complaint that if the patternmaker had done his duty the pattern would have been made to mold more satisfactorily, and a good molder could have put up ten in a day instead of six; that he had to mold it bottom side up anyway, or cope out enough sand to require a bucketful of gaggers, while the patternmaker says plainly that if the foundryman would get molders and coremakers that knew their business they would have no trouble with molding his patterns.

Machine Shop Contention.

The machine shop foreman next takes a hand with his troubles about the castings. They are too hard; they are full of blow holes; the steady-pins in the flask must have been loose and let them "shut over;" but worst of all, the cores were set so badly that the casting won't finish up to the drawing; and he don't see why that patternmaker will have a sixteenth of an inch finish in one place and a quarter in another; what use is there in coring a hole that is to bore out to only an inch when he would rather bore it out of solid metal. So he gives the foundryman and the patternmaker "a piece of his mind."

The foundryman blames the patternmaker again, and warts to know what kind of a casting he can be expected to make from such patterns and core boxes as were furnished him with a core print an eighth, or a quarter of an inch smaller than the core box, and how is he expected to set the core properly if he must dig out the sand all around to get room to do it. Or, he had to mold it the other side up from that intended by the patternmaker, and hung the cores up in the cope so the machine shop wouldn't kick about poor iron on the finished surfaces.

There are ways and means to avoid all these petty bickerings which seriously affect the general efficiency of the men as well as the departments, because of divided and opposed interests and the unnecessary drain on the treasury. It is well known among old shop men that these petty quarrels and this friction are the cause of much delay and expense, for "one hour's quarrel means two hours lost time," since two must necessarily be engaged in it.

Adjustment of Differences.

In cases where the differences recited above occur to any serious extent, it has been the writer's experience in shop management to call in the chief draftsman and the foremen of the patternshop, iron foundry and machine shop and discuss the merits of the case causing the disagreement. Each is likely to defer more or less to the opinions of the others when all are together, and while the consensus of opinion is sometimes that the design of the piece should be changed, it is often contended that the patterns or core boxes are not as correct as they should be; or that there has not been sufficient care used in molding or casting; or that the machinist did not measure up and lay out his casting before

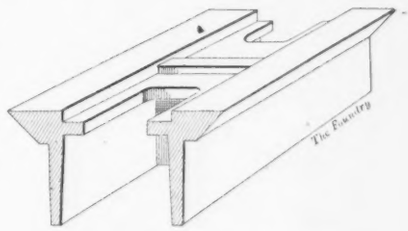

FIG. 2—SECTION OF A LONG SLIDE CASTING

commencing his work; or took too much of a roughing cut off one side and so left it slack on the other, and so on. It is noticeable that when all are in consultation, each will present his side of the case in a less radical way than in the absence of his fellows.

The writer has derived much good from these consultations, not only in arriving at the best solutions of the questions under discussion, but in improving the mutual interest which the department foremen should take in the general conduct of the business.

In considering these questions with a view to increasing the efficiency of the entire establishment for producing really good work owing to the importance of the work of the iron foundry several illustrations in actual shop prac

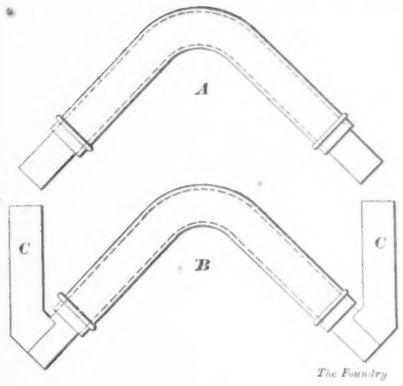

FIG. 3—MOLDING A THIN BRASS ELBOW

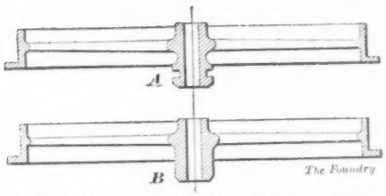

FIG. 4—A FRICTION WHEEL JOB

FIG. 5—THE FORMING TOOL

tice, wherein much good resulted from following the practice of what is often called "making patterns to suit the foundryman," will be given.

Gasoline Engine Piston.

Fig. 1 shows a gasoline engine piston. Its first form is shown at D, in which is seen a heavy loss at the top. This was for the purpose of gripping it in a chuck so as to bore out the inside as far up as the reinforcement bosses C C, for the connecting rod pin, and to turn and finish the outside, after which this boss was to be cut off and the upper face finished. The designer had neglected to consider the shrinkage resulting in shrinkage holes at the point where this top boss joined the thin head at D, and the castings were worthless.

It was proposed to reduce this boss in length, but this did not give sufficient contact with the chuck jaws to hold it firmly. Then it was suggested to make the boss a small, open cylinder or cup, for the same purpose. When this was made thin enough to produce a solid casting it was not strong enough to withstand the pressure of the chuck jaws. Finally, it was removed altogether and the end of the piston itself was gripped by the chuck jaws, was bored out, reamed and the lower edge faced. It was then forced on an accurately turned plug, held in the lathe, and its outside turned and finished and the top faced. A good job was the result and "the pattern suited the foundryman" so well that the loss of castings was reduced to a minimum.

Slide Casting.

In Fig. 2, is shown a short portion of a long slide, the castings being about eight inches wide on top and from seven to ten feet long. Only the top surface and the inclined edges of the dovetailed form were finished. It was the practice to cast the piece in the position shown, allowing the pattern to leave its own core. The result was that the top surface, and particularly the sharp edges were frequently defective. The depth of the lower strengthening ribs prevented the practice of coping out the sand in case it was molded face down. In view of the loss of such a large percentage of the castings it was finally decided to incur the expense of core boxes, have the piece molded face down, and hang the dry sand cores up in the cope. This reduced the losses, which soon paid for the core boxes, and the extra expense of making and setting cores. In addition it left a god margin of profit in the foundry, and saved the expense of the time formerly incurred in the machine shop of partially planing up the castings only to find such defects in them as to render them worthless.

Elbow Casting.

Fig. 3 shows a brass casting of a long, thin elbow with which considerable difficulty was experienced. The pattern was received from the customer in the form shown at A, with core prints projecting the distance shown. Of course there was a tendency when setting the core, for it to sink at the bend, and when pouring to rise at the same point. Various forms of chaplets were tried, but while they served to hold the core comparatively firm, they produced marks in the castings that showed badly when the casting was polished and buffed. This was the case even when brass wire or thin sheet brass was used.

In order to hold the entire core in its proper place the core prints were extended as shown at C C, and the core boxes made to correspond with them. Stiff rods were introduced when the core was made so as to render the core as rigid as possible. The sand in the mold was rammed rather hard around the core prints, and the result was good castings without the blemishes caused by chaplets. Once again, "the pattern was made to suit the foundryman."

Friction Wheels.

A large number of friction wheels, of the form shown in Fig. 4, were to be made. These were to have the hub as shown at A, with a groove for receiving a shipper fork. In the original pattern the form of the hub in the casting was very nearly of the same contour as the finished piece, with the mistaken idea so frequently entertained by theoretical men that the smaller the amount of metal taken off the casting in finishing, machine work could be reduced proportionately. They forget that it is not so much the amount of metal taken off as it is the amount of scale encountered in doing the work, and that the more irregular the contour of a piece the more scale it will have. Aside from this difficulty the irregular contour in a case of this kind necessitates the use of dry sand cores to produce it.

The finishing of these hubs was done with a forming tool as shown in Fig. 5, the piece being held in a chuck, the jaws of which gripped the rim on the inside.

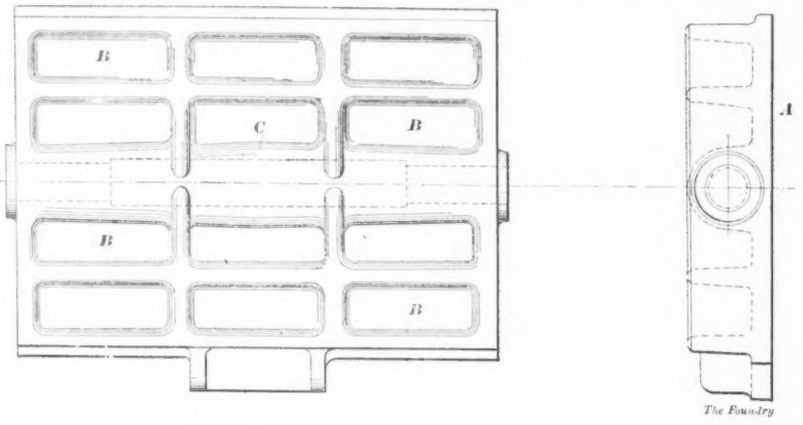

FIG. 6—A PLATTEN CASTING

The difficuties of performing creditable work in a reasonable time led to the changing of the form of the hub to that shown at B, discarding the cores altogether and getting rid of a considerable amount of scale surface which was detrimental to the forming tool. This change enabled more work to be done in a

given time in the machining operations, the work was more accurate and satisfactory, and the castings were produced cheaper in the foundry as the cores were eliminated.

Printing Press Platten.

In Fig. 6 is shown a rear view and an end elevation of a printing press platten, strengthened with deep and heavy ribs in the usual manner. As the pattern was originally made the piece was cast with the finished face A down, to insure sound metal for finishing, while the pockets B, B, etc., were arranged with an extra amount of draft, and the sand was coped out. This operation necessitated the use of many spikes and small gaggers, some of which cut into the narrow portions of the ribs so as to weaken them to a considerable extent, so much so that several of the castings proved too weak to stand up to the pressure brought to bear on them when the finished machine was in operation.

In the original pattern the central sleeve C, had been made the same diameter through its entire length. The recessing of the central portion, as shown, rendered it weaker in the center than at the ends, instead of making the center the stronger as it should have been. In the new pattern that was designed, this portion was strengthened in the center as shown at C, and the ribs made somewhat thicker. The piece was cast on its face as before, but instead of coping out the entire back with green sand and its attendant troubles of spikes and gaggers, the entire back of the casting was formed with a dry sand core hung up in the cope. This method proved successful, the castings coming out clean and sound and none of them has ever shown any weakness. The expense of making the castings was only slightly increased, as the making and setting of the core was not much greater than the time spent in coping out the green sand forming the pockets. The difference in cost was saved many times, as all the castings were sound and perfect, and there was no loss in the machine shop from work on defective castings.

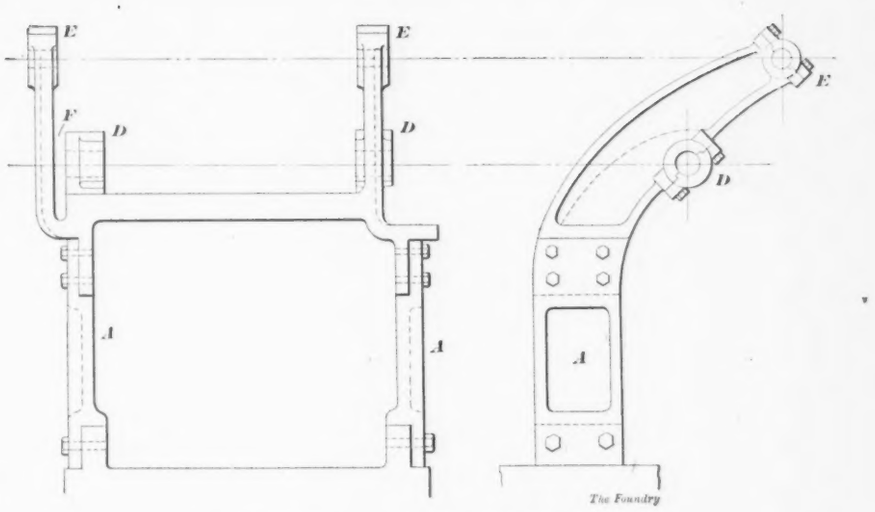

FIG. 7.—SUPPORTING BRACKET—OLD DESIGN

Supporting Bracket.

In Fig. 7 is shown a complicated bracket composed of two uprights A, A, a frame B, and the caps D, D, and E, E. It will be readily seen that the frame is an awkward piece to mold, particularly the ribbed sides and the deep slot at F. This construction necessitated considerable dry sand coring and from its awkward form it was difficult to turn out castings that would machine to the drawings. Again, there was much unnecessary machine work in making the several joints and in the drilling and tapping. The shaft provided for at D, carried a cylinder rotated by a ratchet and pawl device, while the one at E, was for a rock shaft and rotated through less than half a revolution, so that in this latter case a capped journal was not needed.

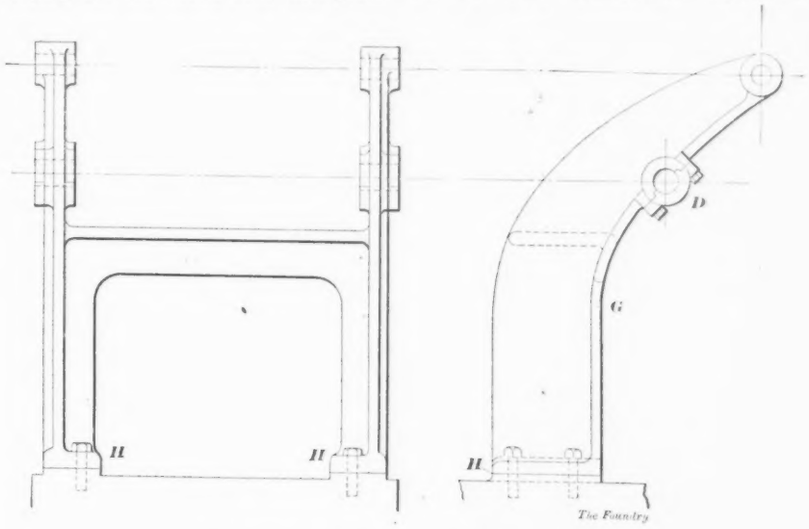

FIG. 8.—SUPPORTING BRACKET—NEW DESIGN

The entire design of the piece was so faulty in form and so complicated in construction, both as to the foundry and the machine shop work, that a new design seemed the only solution.

Accordingly the drawing shown in Fig. 8 was made. This provided for the entire piece, except the two caps for the journal at D. By providing strengthening ribs on one side only, G, no side cores were necessary, and the piece could be easily molded with that side up, the entire piece being in the nowel flask, and no dry sand cores were required. By bolting the feet down to a horizontal surface as at H, H, a more reliable joint and a better opportunity for fitting was secured than the vertical joint shown in Fig. 7.

The expense of casting was reduced about 70 per cent and the machine work about 60 per cent, while the finished product was improved in appearance and much better adapted to the purposes for which it was designed.

In this case, not only was the pattern "made to suit the foundryman," but the castings were made to suit the machine shop foreman.

PLANING DRAFT.

BY H. N. TUTTLE

While a planer with an adjustment for cutting draft is a very convenient machine, the majority of pattern shops are not equipped with them, and it certainly would not pay to throw away a machine which will do good work to replace it with a new one for the single advantage of a draft planing device.

There are several simple ways of using the common planer or jointer for cutting draft which are often more convenient than the use of the adjustable machine. For rough work, such as flask

bars, etc., where an exact amount of draft is not required, it is generally satisfactory to rabbit the piece over the end of the jointer knives as shown in Fig. 1, end view, after which it is again surfaced, cutting away the rabbit to line A B, line C D representing the table with the work upon it after rabbiting. The narrower the rabbit cut out, the greater will be the draft, the height of the table remaining unchanged, as shown in Fig. 2, where the board is cut away to the same depth as in Fig. 1, but only to the center of the piece. In this case, the draft will be nearly double that in Fig. 1, as shown by line E-F.

Often where it is desired to have a definite amount of draft to the piece, pieces of cardboard or thin strips of wood of the required thickness are laid under the edge of the piece while it is

FIG. 1

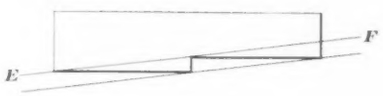

FIG. 2

FIG. 3

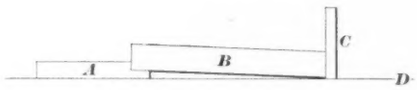

FIG. 4

FIG. 5

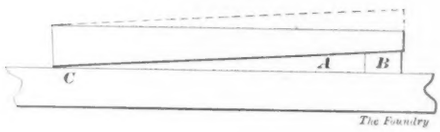

FIG. 6

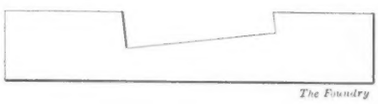

FIG. 7

resting on the back table, the cut being adjusted so that it will just take off the draft.

Another way is to have a few "draft strips," one of which is shown in Fig. 3, being a strip of hard wood 2 or 3 inches wide, and about ⅜-inch thick, with a thin lip A along the lower edge which may be about ⅛-inch wide. The thickness of this lip regulates the draft. If the lip be less than 1-16-inch thick, it may be made by tacking a piece of sheet metal to the bottom of the strip.

Fig. 4 shows its use, A being the draft strip, B the work, C the fence and D the jointer table. The work is dropped into the rabbit of the draft strip, which is then crowded over against the fence with the left hand, while the work is pushed over the knives with the right.

The disadvantage of planing draft on the jointer is that the work generally has to be first run through the thickness planer and then carried back to the jointer, and even then it is not certain to plane an even amount on both ends of the work. The proper place, then, to plane draft is upon the thickness planer, as a rule. This may be accomplished with the "draft board," Fig. 5. This is a thin wide board, somewhat larger and wider than any piece likely to require draft planed upon it, of a definite thickness at one edge, to facilitate measurements, and with a certain draft planed upon it. It is essential to have the board thin, say not over ½-inch at the thick edge, so that after it has become warped or sprung the rolls and pressure feet will hold it down to the bed plate.

In its use, the work is first planed to nearly its required thickness, when it is placed upon the proper draft board, of which there should be three or four, being careful to have it parallel, and one edge flush with the edge of the draft board.

Proper allowance having been made for the thickness of the draft board, the two pieces are now run through the planer together, when the work will come out with the desired amount of draft cut upon it. When the draft runs the other way of the grain, that is, the thick and thin edges at the ends of the board, it is generally sufficient to run the work through the planer upon a parallel board with a strip of wood under one end of the work, thick enough to make the draft, Fig. 6. If the work is thin, it will spring at point A, from the pressure of the feed rolls, in which case the strip B must be replaced by a wedge running from B to C. In this, as well as in most cases of short stuff, it is better to run the work through slightly cornerwise.

When there are many narrow strips to be made which should be exactly alike, as often happens, it is well to cut out a groove in a plank by running it over the top of a buzz saw, with a strip tacked on one edge to give the draft, as shown in the end view, Fig. 7. The strips, after being planed on one side and ripped on the other to within 1-16-inch of finish, are dropped in the groove and run through the planer. In this way the strips are all made exactly alike and are not apt to chatter.

These few remarks will show that while a planer may not be designed for cutting draft it may be made to do good service at such work, with but a very few simple accessories.

MILWAUKEE FOUNDRY FOREMEN.

The last monthly meeting of the Milwaukee Foundry Foremen was held in the rooms of the Metal Trades Association, 32 Hathaway building, Milwaukee, on July 15. The attendance was large and the members entered freely into a discussion of the apprentice question, after which officers were re-elected as follows: Thomas Glasscock, president; Philip Nelson, vice president; J. M. Germanson, secretary; George Dehn, treasurer. It was decided to discontinue the meetings until the first Monday in September.

SMOOTH-ON IRON CEMENT.

Smooth-on iron cements, manufactured by the Smooth-on Mfg. Co., Jersey City, N. J., are comparatively recent products. The original chemical iron compound was made in 1893 by Vreeland Tompkins, a chemical student and graduate of Rutgers college. His object was to make a chemical iron that could be easily applied to cracks and holes in iron to effect permanent repairs. To make such repairs a compound must metallize practically as hard as iron and should expand while metallizing so as to completely fill any opening into which it is introduced. It should also force itself into the grain of the iron and when metallized it must expand and contract the same as this metal. After two years of effort this was accomplished, and a chemical compound was made and named "Smooth-on," which formed the base for the

different Smooth-on iron cements. This cement was first prepared only in a powdered form and used by mixing with a certain percentage of water to the consistency of a stiff putty and immediately applied to cold metal, as it metallized rapidly. While very useful where small amounts of cement were required, it necessitated a hurrying of the work when handling large quantities of this product, that the task might be accomplished before it became too stiff or hard to work.

By further experiments a solvent was found for the above cement which would evaporate upon the application of heat and thus enable Smooth-on to be prepared and maintained in a paste or a fluid form, until required for use. A fluid preparation increased its use, as it may now be applied to hot or cold metal.

There are now six Smooth-on preparations, each made for a special purpose. The one for foundrymen was the first made and was devised for removing blemishes from iron and steel castings. The second compound is designed for use by engineers. The third is for making joints on cast iron hub joint pipes. The fourth is prepared in the fluid or paste form and will flow into very small cracks, holes or seams and is largely used by steam ship engineers. The fifth specialty is known as the Smooth-on iron cement sheet packing and the sixth is the Smooth-on coated corrugated steel gasket.

PATTERN FOR GAS ENGINE FLY WHEEL.

By T. E. O'Donnell

A pattern for a small fly wheel, such as for a gas or gasoline engine, may be made in a number of different ways, depending on the number of castings that are to be made from it. In cases where there are only a few castings to be made it would be economical to build the pattern in the simplest and quickest way, but where there are a number of castings to be made, and especially if it is to be a standard pattern and be laid aside for future use, it will pay to build it in the most substantial manner.

The stock for this pattern should be glued up, the rim being composed of four segments laid to overlap each other as in Fig. 1. The pattern which the writer has in mind has an outside diameter of 24 inches when finished. The segments for this pattern should be one inch thick and cut roughly, on the band saw, to the proper curvature. In striking out these segments, the outside radius is to be taken as 12½ inches, and the inside radius as 8 inches. Before gluing up the segments, they should be planed smooth on both sides and the ends cut down to the proper slant and squared, so that they will fit evenly and touch all the way across. All the segments, of course, should be cut out and fitted in place before the gluing is commenced. To insure that each segment is put back in its proper place, it is advisable to number all pieces, or have them designated otherwise.

To build up the rim, secure a straight grained board one inch thick, or preferably a wooden face plate, and plane it smooth on one side. Mark out on it the approximate diameter of the wheel and saw it out roughly on the band saw.

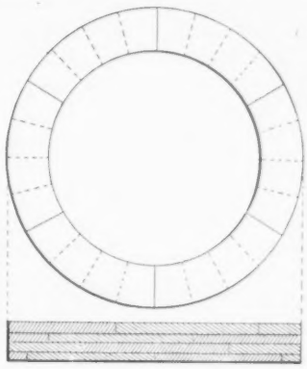

Fig. 1

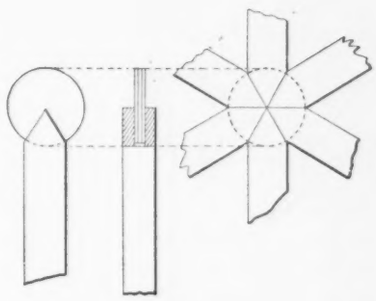

Fig. 2

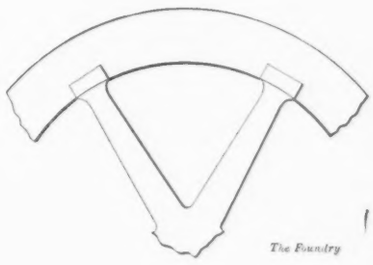

Fig. 3

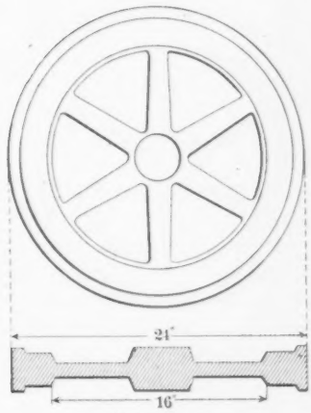

Fig. 4

Lay this on the bench, smooth side up, and lay on the segments in four layers, overlapping at the joints and applying the proper amount of glue. The last, or top layer of segments are not glued on at this time, but are simply nailed in place so they can be readily removed. The segments are then clamped down firmly to the board and the glue allowed to dry thoroughly. When dry, the clamps are removed, the segments fastened to the board by screws from the back and an iron face plate secured to the back of the board. It is then put in the lathe and turned down to its proper dimensions.

The ordinary shop method of building up the six spokes for this pattern wheel would be to use three strips, halving them over. A better method, for making a more substantial pattern, is to segment them together, making six separate spokes and putting them together by means of a web made of strong three-ply material, glued up as shown in Fig. 2. After gluing the spokes in place they are cut off to equal lengths, leaving them long enough so that when laid upon the rim, as in Fig. 3, they will overlap the inner edge of the rim from 1 to 1¾ inches. Before doing this, the top row of segments of the rim which were merely nailed on for turning should be taken off. The places where the spokes overlap are then marked off and notches are cut in the rim, wide and deep enough to allow the spokes to drop in flush with the top of the rim. The spokes are just cut out roughly to the required size and are then glued in place. The spokes being in place, the top row of segments, which was removed temporarily, is then glued in place permanently, after which it is trued up and the spokes dressed down smooth. The hubs and core prints may then be turned and put on, the same as in any ordinary pattern of this type. The object of building a pattern in this way is to get one which will wear. Fig. 4 shows the pattern complete.

DESIGN AND CONSTRUCTION OF FOUNDRY BUILDINGS*

Description of Plants Designed and Built by the Author for Both Jobbing and Specialty Work

BY GEO. K. HOOPER

THE foundry business has become so specialized and such rapid strides have been made in the elementary knowledge of the methods and requirements of manufacture that it is difficult to make any general remarks on the subject of foundry construction. I will, however, endeavor to describe some of the plants which I have designed and which comprise foundries devoted to the casting of the smallest forms of large sections with practically no core work, to the most specialized shops using machines almost exclusively.

For plants engaged in heavy work I have made designs in two ways. In one instance, owing to the form of the site and the location of the railroad tracks, it was found advisable to place the stock house and melting equipment at one end of the foundry permitting all of the other operations to divide from that point as a basis. For this shop a straight open building, three bays in width, was built, the second bay having been provided with cranes of sufficient capacity to handle the largest ladles, as in this case the work was such that the ladle of iron was the heaviest thing to be handled. Single rail electric travelers were also installed in the main and side bays, provided with suitable wedges to facilitate their movement from one department to another. In addition to serving the foundry these trolleys were used for cleaning up and for conveying scrap, sprues, gates, etc., from the foundry to the stock house.

The melting equipment was in the middle of one end of the foundry and was separated from it by a brick wall. The spouts of the cupolas projected through the latter and were adjustable so that large or small ladles could be filled at any distance from the furnace. The brick wall also kept the slag fumes out of the foundry and the drop was likewise confined, which made the work of cleaning up comparatively easy. The cored and small work was done close to the cupolas, while the large work, on which the temperature of the iron could vary considerably without affecting the castings, was placed where most convenient.

Cleaning Department.

The cleaning department was located at the end of the building opposite the cupolas, partly in the center and partly in the side bays, the design being such that as the foundry increased its output the building could be increased in length and the cleaning equipment moved along to provide additional molding space. With the growth of the plant in view, mills, grinders, and the sand blast machine were placed as far down as possible, that they need not be moved until the second extension to the foundry was made. The contour of the site was such that the waste material could be moved out of the side and end of the shop for filling purposes.

Owing to the peculiar location of the railroad tracks, the stock house was placed across one end of the building and the track was extended up to the charging floor, making it possible to unload several carloads of coke and iron on to this floor. The space underneath the trolley was utilized for the storage of iron, coke, sand, fluxing material, etc., and the whole was enclosed by a like building which contained a single rail electric traveler for handling material to the cupolas and the foundry, and which connected with the trolleys in the latter.

Main Building.

The main building was of steel frame construction, with brick curtain walls, and was provided with a wooden roof covered with slag roofing and with large, wooden frame sliding sash windows. The floor of the foundry consisted of molding sand laid on filling, although no pit work was done. Ventilators with tilting sash operated from the floor extended practically the width of the center bay, and while there were no skylights, sidelights were depended upon for all of the illumination, the windows having been carried as high as possible for this purpose. Large galvanized iron ventilators were placed in the roof at every other bay, to provide for the circulation of air when not pouring and in inclement weather.

The foundry was about 350 feet long, and if it were increased in size to make other melting equipment necessary, the cupolas would be installed at one side sufficiently far down to conveniently distribute the iron according to the varying classes of work to be poured. It is not probable, however, that this will be done, as there seems to be no reasonable limit to the distance which a ladle of iron for heavy work can be carried.

Foundry for Machinery Castings.

A foundry of another type for the production of medium and large machinery castings, with a fair proportion of cored work, was laid out partly in accordance with the contour of the site on which it was located, due regard being given to the location of the railroad tracks. This foundry was of the usual three-bay type, having one large center bay and two smaller ones on either side. The stock house was placed at one side of the property adjacent to the railroad track and contained all of the raw materials except the iron, which was carried in the yard commanded by a crane. The stock house has an elevated track extending through it, that all supplies could be dumped by gravity from the cars in which they were received and thereafter conveyed under cover into the foundry. This stock house need not

*Presented at the Philadelphia Convention of the American Foundrymen's Association.

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darken the side of the foundry which it adjoins, since it can be located far enough away to permit the placing of windows down to a level about seven feet above the floor, with a light well at least twelve feet wide. In any event it makes little difference whether the light is somewhat obstructed on that side, since the melting equipment occupies some of it, and with a foundry for this class of work there are core ovens, drying ovens, sand mixers, core storage, coremaking, and other departments which do not require much light, while others can be suitably lighted by skylights.

The coke is raised to the charging floors on cars by means of a plunger elevator, while the iron from the stock yard is carried by a single rail traveler directly on to the charging floor.

Both the melting and cleaning departments are fixed points in this scheme, the foundry with its stock house and yard growing away from these departments, and additional melting equipment can be placed in the side bay if required.

Cleaned castings are stored in a yard or building at right angles to the foundry, communicating with the machine shops. As there is considerable core work a large amount of refuse has to be elevated by cheaply built conveyors to a set of overhead bins, discharging into cars or wagons.

Since a foundry of this type will have some pit work, the flooring will naturally consist of sand to a considerable depth with brick or concrete floors in the cleaning department. The cleaning floor space will absorb some of the molding room as the foundry is extended, but otherwise this department will not be disturbed.

This type of plant presupposes a large establishment divided into departments, castings being made at the option of the foundry rather than in response to some demand from the machine shops. This plant is to be built with masonry walls having a wooden roof covered with slag or gravel, wooden window sash, partly sliding and partly tilting, large monitor with tilting sash, galvanized ventilators, core room partitions fire proof, and with floors in front of the drying ovens and the core room of concrete construction.

Foundry for Chilled Castings.

Another type covering several classes of large work is designed to grow in two directions, being devoted to a large amount of chilled work. The melting equipment, including air furnaces, is located in the center of the building, and the space immediately in front is occupied by the ladle and chill storage and ladle mending departments. Inasmuch as the molds for the sections made in this plant are cast on end, a proportionately greater tonnage can be secured from a limited floor space, as compared with a plant where floor molding is done exclusively. Considerable room is required in a shop of this kind for handling ladles. Separate power cranes are also required for each pit and liberal head room is necessary. The floor about the pits in front of the drying ovens should be made of concrete. The growth of the other end of the plant devoted to the production of general castings will be similar to that of the large foundry already described.

Arrangement of the Plant.

A plant of this kind may be divided into three or more bays, the furnaces being so located that they are accessible to the main bay cranes. The stock house and iron storage may be located as previously explained. The charging floor, on account of the cupolas necessary to supply all of the mixtures required, should be served by an overhead crane which can carry large pieces of scrap and carloads of pig iron to any cupola or furnace.

While the area required per molder in lighter gray iron work may be as great or even greater than in heavier work, the tonnage handled is proportionately much smaller. Frequently no overhead equipment is required, tracks or trucks being amply sufficient for handling the iron. Certain floors may require comparatively large amounts of iron and separate handling appliances, but in general the buildings will be divided into bays, with the melting done at one end or one side and the cleaning department directly opposite. The pickling department should be located away from the natural line of growth so that extensions will not disturb this department. For this class of work the core room can be established at a distance from the foundry and it is not essential to have it directly in or adjacent to the foundry building.

The stock sheds and iron storage should, of course, be convenient to the melting department and the overhead crane is not essential to the iron yard. Tracks and cars connecting with the elevator are as economical as a yard crane, when all of the handling is considered. A separate building should also be provided for the storage and repair of molding machines.

In a foundry of this type it will be found necessary to install light overhead travelers which can serve either the molders or the machines and which, in any event, can handle the iron. Considerable space is also necessary in a plant of this kind for stacking flasks, as it is not practical to have a large flask yard or to build a separate structure for them. Galleries can be used very well as storage room.

Plants Equipped for Special Work.

Foundries equipped with machines for special work will next be considered. They can be built several stories in height with a foundry on the upper floor and the other departments underneath; or where there are a number of foundries in a group, the buildings should be two stories, with a foundry on the top floor. The various foundry buildings should be located so as to conveniently receive their supplies from one stock house and their cores from another, with a pattern storage and repair department over one or the other of these buildings. The buildings should be designed with sufficient head room in the lower story to accommodate large tumbling mills with a platform over them for suitably distributing stock, the mills being high enough to dump their contents either into barrels or onto conveyors. A floor should also be provided for the foundry with a frame for a suitable grating through which the sand can be dropped and on which castings can be piled after shaking out.

The roof should have sufficient strength to support travelers for carrying the molds and iron, and all bracing should be kept above the trusses as far as possible to provide for conveyors for handling sand to the molding machine hoppers. The trusses should be designed with a stiff lower chord and should be of such form that the apparatus may be fastened to it anywhere without punching or drilling. A durable floor can be made of paving brick laid on planks with a cushion of sand, the planks having previously been covered with a waterproof material to prevent dry rot. A floor of this kind can be changed for any purpose more easily than one of steel or concrete and is furthermore much lower in first cost.

The castings are dropped through chutes in the floor to the mills below, where the sorting, cleaning and grinding are done, although a certain amount of sorting can be done on the foundry floor by judiciously locating the machines on similar work.

Continuous Work.

Plants for highly specialized work, involving carriers for handling molds, flasks, castings, etc., will next be considered. There are two types, one with the building two or more stories in height, with a carrier on the upper floor, while the other has the carrier and the other departments on the ground floor. The price of the real estate and the size of the cores largely govern the design of a plant of this kind, as the

output is large in volume and must be handled by conveyors, and there is little advantage in the use of gravity.

I have built plants of both types and have found either well suited for the work for which it was planned. In one case the core room and core storage were located so that the cores for all classes of work could be placed on the carrier with a minimum amount of handling and each car of the carrier brought a fresh core to replace the one taken away. All departments, including the cleaning room, were on the ground level. Such a plant requires a large amount of light and ventilation and windows and skylights are placed wherever possible. The floors are preferably of concrete, as practically no sand collects upon them and as the pouring is done while the flasks are in motion on the carrier, there is little danger of spilling or splashing iron. In another plant producing very small castings the carrier was placed on the second floor and the finished sections were delivered by means of a conveyor through a separator and cooling tank to a continuous cleaning apparatus on the first floor. The cores were handled in trays.

The roof of such a foundry should be very heavy and substantially braced in all directions, as it must support considerable overhead conveying apparatus for the handling of sand with concentrated loads at various points where the sand happens to be located. The floor should be of brick or concrete, preferably the former, for reasons which I have already given. There are no great floor loads with carriers, but a complicated flooring system is usually necessary on account of many conveying devices which are used. In the construction of buildings brick walls, either with or without steel columns for supporting the trusses, have been used.

Types of Construction.

There are other forms of wall construction from which choice can be made, such as reinforced concrete, concrete plaster on wire lathe, concrete blocks, terra cotta hollow blocks with or without steel reinforcing strips, brick, corrugated iron, and wood. The last two are rarely used at present, wood being objectionable on account of the fire risk, and corrugated iron in view of its short life. Of the other materials the question of relative cost is a large factor, and a suitable selection must be made to fit the case in hand.

I have always presented plans of all my buildings to the reinforced concrete contractors, that they might compete with the other forms of construction, but I have not yet been able to secure a bid or to have a building built as cheaply by them as from other materials, and when I say this I accord due appreciation to the question of insurance, as locality and contents are considered by the underwriters as well as the type of the building.

I am somewhat opposed to reinforced concrete on account of its lack of what I term "manufacturing elasticity," since it does not adapt itself very well to alterations and extensions which are constantly being made in plants devoted to foundry work. Brick, concrete blocks, and hollow tile are the most adaptable, brick probably being more so than any of the others. Considering the present price of brick, no saving can be effected by the use of the other two forms of covering, although in the large foundries to which I refer, the weight of the steel can be maintained at the minimum by the use of hollow tile above the windows.

For interior partitions hollow tile makes a firm, cheap wall. Concrete plaster on wire lath, expanded metal, or galvanized netting usually requires so much supporting steel that it is quite expensive and practically costs more than brick and does not possess the advantages of the latter.

Steel roof trusses should be carefully designed so that they may be conveniently reached with cleaning and paint brushes, especially in foundries of the continuous type, where considerable vapor arises from the cooling sand. The trusses and columns should be carefully and thoroughly painted. Roofs are cheaply constructed of wood, with slag or gravel covering. This covering is favored in view of its low first cost, as against slate, tile and special forms of reinforced concrete. I have had only one disastrous experience with a roof of this kind and that was due to the fact that the sprinkler system had not yet been connected.

Windows except where there is an exposure, are generally made with wooden frames, glazed with factory ribbed glass and should be fitted to tilt, thereby securing the greatest possible opening. There was at one time a craze for making walls almost entirely of glass and steel. These buildings, however, are difficult to heat in winter and to ventilate in summer, while the glare of the direct sunlight is most unpleasant. Many plants of this kind have adjusted curtains to the windows and have glazed portions of the windows and in some cases large sections have been removed.

A building wall containing 50 per cent of window space will usually be very completely lighted for any width of structure and in any event passages and storage departments can be placed in the darker sections.

I am an advocate of metallic bars and ribbed glass for skylights, and in continuous foundries where a large amount of vapor is present a copper bar is cheapest in the end.

All of the floors I have described have been used successfully, but there is one type that I have not referred to and which is built of ordinary brick, with rails laid thereon, over which the flasks of the machines can be moved as the case may require. The rails should be laid down on sleepers in a sub-base of concrete, if this floor is on the ground level. The floors of the charging departments should be made of steel plates without tracks or in fact any ridges of any kind to interfere with the free movement of trucks and the use of shovels or forks. The cupolas should be set fairly high so that a man may work conveniently under them and to facilitate also the handling of ladles of various sizes. This is especially a desirable feature for continuous foundries where a ladle reservoir is provided with a skimming device which is located between the cupola and the pouring ladle.

The charging door I usually make very large, with a heavy cast iron curb, that a truck of scrap or coke may be run right up to it and dumped in. The opening is best protected by a wire screen raised and lowered by counterweights. The installation of spark deflectors depends somewhat on the location.

I sincerely hope that some one will soon devise a practical cupola blast regulator. I have some ideas on the subject myself, but have been too busy to develop them.

Depending on the work, I advise from 11 to 14 feet above the tuyeres as the proper height of the opening in the cupola for economical and rapid melting. After considerable experience with tuyeres of various types, I still adhere to the old-fashioned square box tuyere as being the most reliable and efficient. Blowers vary in accordance with the service they are to render, my preference being for a positive blast blower for cupola work, with independent engine or motor, as circumstances may dictate. The motor should be provided with a speed regulator to control the melting, the latter being imperative for continuous practice. For air furnaces the centrifugal blower seems to be best adapted, a simple unloading device being sufficient for its regulation. It is, of course, needless to say that the larger the fan within reasonable limits, the smaller the consumption of power.

I also advocate the slagging of the iron as the melting proceeds, and the tonnage of the heats will naturally indicate whether or not a special conveying

STANDARD SPECIFICATIONS FOR FOUNDRY PIG IRON.*

Analysis.

It is recommended that all purchases be made by analysis.

Sampling.

In all contracts where pig iron is sold by chemical analysis, each car load, or its equivalent, shall be considered as a unit. At least one pig shall be selected at random from each four tons of every car load, and so as to fairly represent it.

Drillings shall be taken so as to fairly represent the fracture surface of each pig, and the sample analyzed shall consist of an equal quantity of drillings from each pig, well mixed and ground before analysis.

In case of disagreement between buyer and seller, an independent analyst, to be mutually agreed upon, shall be engaged to sample and analyze the iron. In this event, one pig shall be taken to represent every two tons.

The cost of this sampling and analysis shall be borne by the buyer if the shipment is proved up to specifications, and by the seller if otherwise.

Allowances and Penalties.

In all contracts, in the absence of a definite understanding to the contrary, a variation of 10 per cent in silicon, either way, and of 0.02 sulphur, above the standard, is allowed.

A deficiency of over 10 per cent and up to 20 per cent, in the silicon, subjects the shipment to a penalty of 4 per cent of the contract price.

Base Analysis of Grades.

In the absence of specifications the following numbers, known to the trade, shall represent the appended analyses for standard grades of foundry pig irons, irrespective of fracture, and subject to allowances and penalty as above:

Grade	Per Cent Silicon.	Per Cent Sulphur (volumetric)	Per Cent Sulphur (gravimetric)
No. 1	2.75	0.035	0.045
No. 2	2.25	0.045	0.055
No. 3	1.75	0.055	0.065
No. 4	1.25	0.065	0.075

Note—For the sulphur determination the gravimetric method is recommended in the event of dispute.

*Adopted by the American Society for Testing Materials by letter ballot, November 15, 1904.

THIS TABLE HAS BEEN ARRANGED FOR THE RAPID CONVERSION OF GROSS TONS AND FRACTIONS THEREOF INTO POUNDS.

Equivalent of Gross Tons (2,240 Pounds) in Pounds.

Tons.	Pounds.	Tons.	Pounds.	Tons.	Pounds.	Tons.	Pounds.
15	33,600	24	53,760	33	73,920	42	94,080
15¼	34,160	24¼	54,320	33¼	74,480	42¼	94,640
15½	34,720	24½	54,880	33½	75,040	42½	95,200
15¾	35,280	24¾	55,440	33¾	75,600	42¾	95,760
16	35,840	25	56,000	34	76,160	43	96,320
16¼	36,400	25¼	56,560	34¼	76,720	43¼	96,880
16½	36,960	25½	57,120	34½	77,280	43½	97,440
16¾	37,520	25¾	57,680	34¾	77,840	43¾	98,000
17	38,080	26	58,240	35	78,400	44	98,560
17¼	38,640	26¼	58,800	35¼	78,960	44¼	99,120
17½	39,200	26½	59,360	35½	79,520	44½	99,680
17¾	39,760	26¾	59,920	35¾	80,080	44¾	100,240
18	40,320	27	60,480	36	80,640	45	100,800
18¼	40,880	27¼	61,040	36¼	81,200	45¼	101,360
18½	41,440	27½	61,600	36½	81,760	45½	101,920
18¾	42,000	27¾	62,160	36¾	82,320	45¾	102,480
19	42,560	28	62,720	37	82,880	46	103,040
19¼	43,120	28¼	63,280	37¼	83,440	46¼	103,600
19½	43,680	28½	63,840	37½	84,000	46½	104,160
19¾	44,240	28¾	64,400	37¾	84,560	46¾	104,720
20	44,800	29	64,960	38	85,120	47	105,280
20¼	45,360	29¼	65,520	38¼	85,680	47¼	105,840
20½	45,920	29½	66,080	38½	86,240	47½	106,400
20¾	46,480	29¾	66,640	38¾	86,800	47¾	106,960
21	47,040	30	67,200	39	87,360	48	107,520
21¼	47,600	30¼	67,760	39¼	87,920	48¼	108,080
21½	48,160	30½	68,320	39½	88,480	48½	108,640
21¾	48,720	30¾	68,880	39¾	89,040	48¾	109,200
22	49,280	31	69,440	40	89,600	49	109,760
22¼	49,840	31¼	70,000	40¼	90,160	49¼	110,320
22½	50,400	31½	70,560	40½	90,720	49½	110,880
22¾	50,960	31¾	71,120	40¾	91,280	49¾	111,440
23	51,520	32	71,680	41	91,840	50	112,000
23¼	52,080	32¼	72,240	41¼	92,400	50¼	112,560
23½	52,640	32½	72,800	41½	92,960	50½	113,120
23¾	53,200	32¾	73,360	41¾	93 520	50¾	113,680

Note—This sheet may be cut into two sections, 5 x 7 inches, and may be readily bound in note-book form.

THE FOUNDRY DATA SHEET, SEPTEMBER, 1907.

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication.

apparatus should be used for handling this slag. A wheelbarrow is, of course, the simplest device.

Raw Materials.

The coke should be kept under cover and handled as little as possible. Scrap should be handled according to its nature, as no single method will answer for all grades, although the magnet seems to be more adaptable than any other method. A system of handling pig iron will depend upon the amount consumed. Small quantities for small cupolas which must be broken can be handled more cheaply by common labor, while large tonnages offer a prolific field for the use of a magnet and adds considerably to the storage space. I have yet to be convinced of the value of a cupola charging machine. Storage yards for charging materials should be served by an overhead crane and industrial tracks should be used as little as possible.

Plunger elevators are best adapted for charging floor service. Whether the machine should operate directly by hydraulic pressure or with some elastic medium interposed between the water and the source of power will depend largely upon conditions. In large foundries and especially for continuous work, I usually provide a speaking tube between the melter and the charging floor that the chargers may supply coke in accordance with the demand for iron from the floor. From this you can see that the melting ratio is of comparatively little importance in this work, when compared with the cost of a completed mold. Frequently the core alone costs several times more than the coke employed in melting the iron.

Cranes.

For handling large flasks I prefer a locomotive crane, as it gives the greatest flexibility with the least expense. The practice of running an overhead crane through an opening in the end of the building is very expensive and unsatisfactory, requiring as it does expensive building construction. It is furthermore impossible to keep tight against the weather while the flask yard is limited to the space directly in line with the crane runway and generally in line with and obstructing the growth of the foundry. By the use of the locomotive crane a site of any shape can be utilized and the crane can enter the foundry at almost any point. As it is operated by steam, it can be driven independently of the plant. For indoor flask storage, trucks and elevators provide suitable and convenient means for handling.

Belts of a liberal size with bucket elevators are best adapted for handling sand when it is to be delivered to the various parts of the foundry mechanically. Belts may safely be used for receiving hot sand dumped out of flasks, though containing many sprues, much shot and chaplets. Belts also may be used for handling flasks in continuous work even though they are hot and of considerable weight. I also advocate sand riddles with bronze wire, as it lasts longer than iron, steel or brass. Wood or reinforced concrete is the best material for sand hoppers, conveyor troughs, etc., while all the advantages are in favor of wood.

Continuous Systems.

In designing continuous systems, whether wholly or partly automatic, care should be taken to keep the various operations independent of each other that any interruption to any one may not affect the others. The efficiency of this method of producing castings depends largely on the care given to this feature. I have known of some who have failed entirely as a result of the too close adjustment of the various operations, whereas a little room between them would have made the plant a success.

Core rooms naturally depend on the nature of the work. For large and intricate work they should be located in the foundry, while others can be placed in separate buildings and can deliver the cores to the foundry on conveyors and can later be distributed by boys. For making cores of moderate size to be handled in dryers, I advocate that the benches should be so spaced that the oven cars can operate between them, permitting the finished cores to be placed directly on the cars and when filled they can be run directly to the ovens over suitable tracks. After the cores are baked the cars can be delivered to the core storage room, thus obviating unnecessary handling.

For cores of large or moderate size I prefer an oven which has a long arch at the bottom with fire and combustion chambers underneath and the heat thus radiated will circulate through every part of the chamber. For small cores I had devised an oven heated by oil or gas containing a conveyor. Learning later that the same could not be patented owing to a previous right on a continuous baking machine, I lost interest in the same. A plant which I built has eight of these in operation, using oil in conjunction with waste heat from the malleable annealing ovens.

When cranes and tracks are used, care should be taken to prevent points of congestion at meeting or transfer places.

A CAST STEEL TRIANGULAR EQUALIZER

BY H. J. McCASLIN

MANY are the problems that are encountered from day to day in the steel foundry, and many sections now cast in steel would have been a product of the blacksmith shop in the not far distant past.

Fig. 1 shows an equalizer of triangular form, with its three links cast in

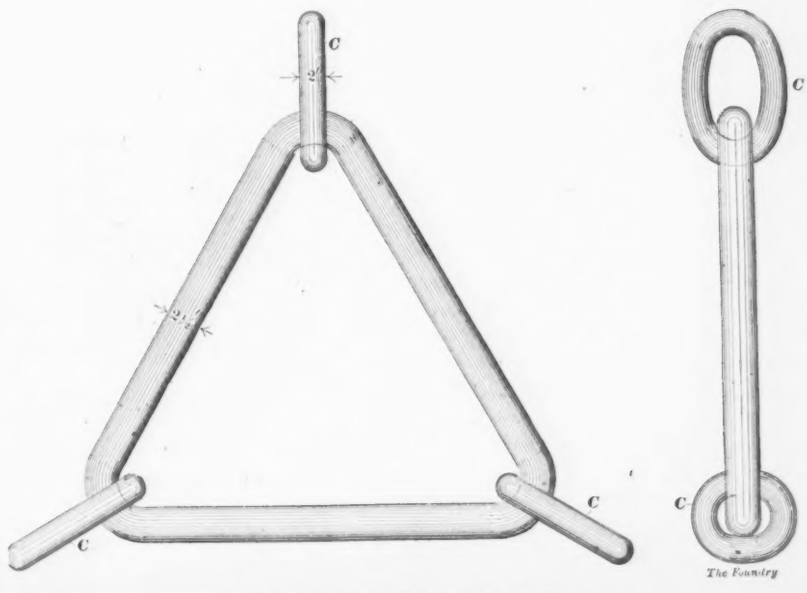


FIG. 1—TRIANGULAR EQUALIZER

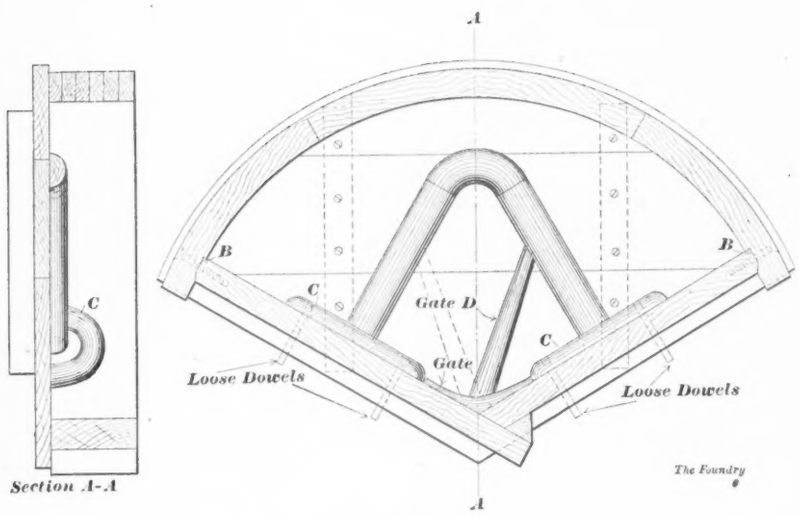


FIG. 2—CORE BOX

one operation. When only one is required it becomes a job for the blacksmith shop, but when a number are required they may be cast in steel with good results, and at a lower cost.

The method of molding devised is that of a cored mold consisting of six half cores, each half core containing a part impression of the object to be cast. In arranging the mold the six cores are so placed upon a level bed that they form the required gating and a complete impression of the section.

While Fig. 1 shows the three links C in their respective locations, their casting position, or their depression in core, is at the center of the straight section of the triangle. This arrangement not only simplifies the construction of the core box, but increases the sand about the links, and greatly facilitates the manner of gating as shown in Figs. 2 and 3. The pattern work required is in the form of a core box shown in Fig. 2. While its construction is self explanatory, its arrangement may bear a few remarks.

To allow its free removal from this core it is parted at B, and secured together with screws. This construction allows the material which forms the radial sides, and which should enclose an angle of 120 degrees, to be rigidly secured together at the intersections as shown. Secured to the bottom board of the box is a one-half pattern of one-third of the triangular link. Attached with loose dowels to the radial sides of the box are the two quarter link patterns C. To assure the matching up of the depressions formed by these part patterns, accuracy must be maintained in locating and securing these parts in their correct positions. The gating is arranged as shown with gate D detachable, as this gate is only required in forming the three bottom half cores.

Fig. 3 shows the assembled cores or completed mold. To illustrate more fully the arrangement, the figure shows the upper half of one of the cores removed. The upper and lower half cores having been carefully pasted together, a bed is struck off, and the three complete cores accurately placed together as shown. A round flask or curbing is now placed around the cores and the space thus formed firmly backed in with sand. The runner core which is not shown in place at the center of the mold is placed in position. Plates having been placed over the cores, the weighting down of the mold is in order.

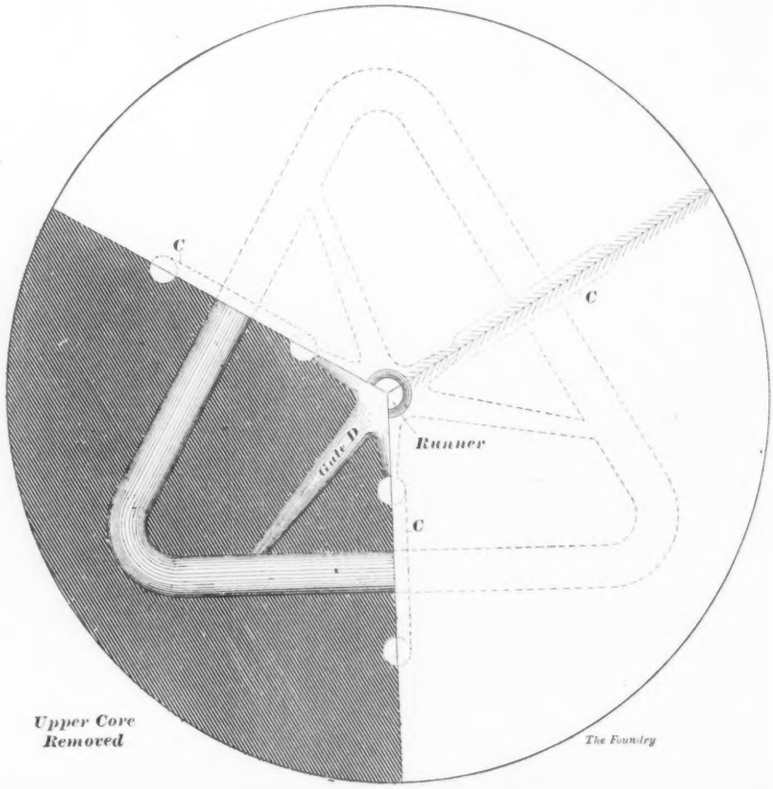


FIG. 3 —ARRANGEMENT OF CORES

CLEVELAND CLUB OF ASSOCIATED FOUNDRY FOREMEN.

The monthly meeting of the Cleveland Club of Associated Foundry Foreman was held at the American house, Cleveland, on Saturday evening, July 27. At a previous meeting a committee was appointed to make arrangements for an outing, but owing to the difficulty experienced in securing a suitable date, the matter was laid on the table indefinitely. John C. Knoeppel, of Buffalo, displayed models of a system of tuyeres which he has designed for cupola work, together with the method of constructing the lining and certain arrangements for the introduction of air above the melting zone. His remarks were extremely interesting and resulted in considerable discussion.

EFFECT OF SEA COAL ON SAND.

Question.—Will you kindly advise me whether sea coal facing mixed with the entire body of the sand in car wheel manufacture will have a tendency to strengthen or weaken the same.

Answer.—Many conflicting replies have been received from car wheel makers, and the experience of others is solicited.

TESTS OF SOME BRASS AND BRONZE BARS

Results of a Series of Interesting Experiments to Ascertain Their Chemical and Physical Properties

BY HARRY B. de PONT

IN AN article published in the June issue of THE FOUNDRY last year, the author gave some data on "Brass and Bronze for the Automobile," dealing entirely with castings for the various uses on these machines. It is the object of this article to continue the subject, but treating entirely with the chemical and physical properties of standard test bars. These bars, as previously explained, were taken from the same heats as the castings, wherever it was possible, but owing to the desire to run a regular system of physical tests, many of the bars in question were cast from heats different from those from which the castings were made.

First, three bars were made, a tension bar, a transverse and a compression piece. Drillings were taken from the ends of the transverse and tension bars in such a way as not to interfere with the physical tests. Owing to the smallness of the compression pieces they were given the physical tests without being drilled for analysis. The transverse tests were exceedingly unsatisfactory, by reason of the bar bending and exhibiting no exact point which could be used as other than an approximate demonstration of its transverse strength, therefore the bars were discontinued and all interest centered on the working of the tension bars.

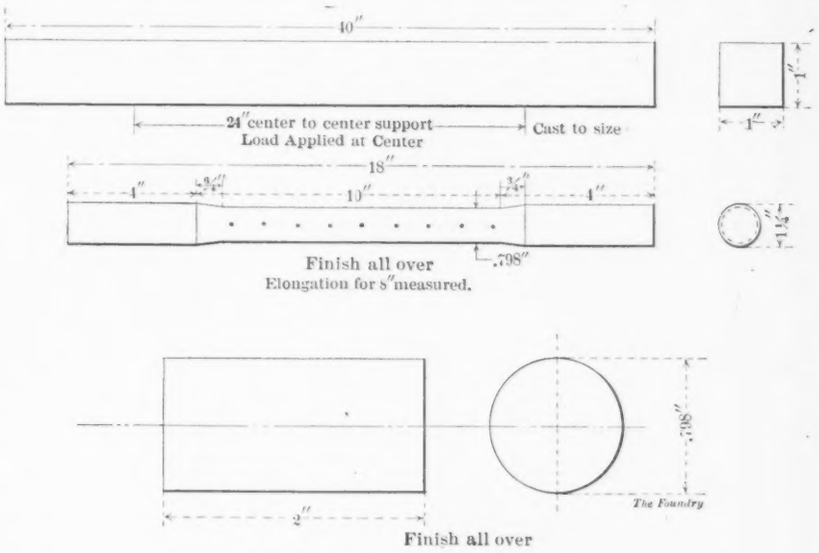


FIG. 2.—STANDARD TEST PIECES.

Material ..... Anal. No. .....
Ultimate Strength in Tension.....
Elastic Limit .....
Per cent of Elongation in 8 inches.....
Reduction in Area.....
Ultimate Strength per Square Inch in Compression.....
Modulus of Elasticity.....
Transverse Strength 24 inches Center to Center.....
Modulus of Transverse Elasticity.....

	Cu	Sn	Zn	Pb	Fe	Mn	P	Sb
Analysis of Tension Bar.....								
Analysis of Transverse Bar.....								
Analysis of Casting.....								

Drawing No. of Casting.....Name of Casting.....
Remarks .....
.....
Shelf No. .....

FIG 1.—INDEX CARD.

Dimensions.

The dimensions of the bars are indilated as shown in Fig. 1, and placed on lated as shown in Fig. 2, and placed on an index card, 5 x 8 inches.

Before entering upon a discussion of the subjeect we wish to call attention to the fact that the bars labeled "brass" or "bronze" as it happens, were bought as such on specifications and did not derive their names from their respective analyses. According to late theories and formulas, the names of the bars as given here are misnomers and by reason of their combination of elements would fall into a class by themselves, or rather, would be represented by special formulas made up of the elements in order, with their respective percentages in subscript.

Definition of Brass and Bronze.

Primarily, brass is an alloy of copper and zinc and bronze an alloy of copper and tin. So, if by chance other metals in small quantities happened into a mixture of supposed copper-tin, is there any particular harm in calling the product of such a heat or mix, bronze, or are there any logical reasons for applying some other name to the product? We will not discuss the point further, but will, for the sake of a name, speak of the alloys here as "brass of bronze" regardless of what they might be.

The physical data were obtained by parties directly connected with the laboratory for chemical analyses, which data, together with the fractured ends of the tested bars, were filed away. The tension bar holds for all data throughout this article, with the exception of a few tests on the compression cylinders, the transverse bar having been discarded. In order that the tension bars may have an uninterrupted discussion, we will begin with the data on the compression piece. No chemical data having been obtained, these pieces cannot prove their identity by their respective analyses.

Table I.

		Ultimate strength in compression. Pounds per square inch.
No. 1	Brass	142,650
No. 2	Brass	143,450
No. 3	Brass	127,850
No. 4	Bronze	178,920
No. 5	Brass	121,000
No. 6	Brass	145,200
No. 7	Brass	149,300
No. 8	Brass	151,350
No. 9	Brass	123,800
No. 10	Bronze	171,200
No. 11	Bronze	160,000
No. 12	Bronze	158,000

Tension Data.

The bronze cylinders in Table I have the highest ultimate strength in tension, but it will be noticed throughout the tables that the bronze bars shift about a great deal, following, however, the general idea that copper and tin give high ultimate strength in tension. The entire tension data is given in Table II.

The measure of force used is expressed in pounds per square inch, as ultimate strength in tension, 30,000 pounds per square inch, etc. The analysis table shows a copper variation of nearly 7 per cent; tin about 5 per cent; zinc about 9 per cent, and lead, from a trace, to nearly 3.75 per cent. The variation in the ultimate strength per square inch in tension reaches 11,170 pounds, the lowest ultimate strength for No. 16 bronze and the highest for No. 4 bronze.

Table II.

No.	Name.	Copper.	Tin.	Zinc.	Lead.	Iron.	Antimony.	Ultimate strength per square inch in tension.	Elastic limit.	Elongation in 8 inches, per cent.	Reduction in area, per cent.	Elastic limit in tension.	Ultimate strength, per cent.	Modulus of elasticity.
1	Bronze	84.4	9.421	2.42	2.64	trace	.117	30,290	19,500	12.7	15.1	64.4		2,178,300
2	Bronze	82.6	10.06	7.3	....	.....	....	32,395	19,920	10.6	15.5	61.6		2,425,000
3	Brass	81.27	6.16	10.38	2.06	0.03	....	30,415	17,900	19.8	18.5	59.0		1,770,000
4	Bronze	82.71	10.68	6.4	....	0.12	....	34,930	21,870	15.0	18.9	62.7		4,149,000
5	Bronze	84.23	9.78	2.17	3.68	trace	.12	27,100	13,930	9.4	12.5	51.4		4,781,500
6	Brass	85.65	6.18	5.76	2.12	0.26	....	27,085	16,230	13.3	20.3	60.0		
7	Bronze	81.50	10.00	7.63	0.78	.....	....	28,200	16,480	7.3	12.3	58.4		
8	Bronze	83.29	8.74	4.08	3.26	0.61	....	32,380	20,000	10.5	14.8	61.8		
9	Bronze	84.98	8.52	4.94	1.01	0.59	....	32,000	17,800	8.6	15.8	55.6		8,000,000
10	Bronze	83.01	10.26	6.6	trace	0.12	....	28,200	18,620	6.6	14.4	66.2		5,798,000
11	Bronze	81.91	10.76	4.42	2.78	0.02	....	28,850	18,000	5.8	7.6	69.6		2,948,000
12	Bronze	82.46	11.93	2.24	3.22	0.126	trace	30,600	18,000	5.9	9.2	58.8		6,500,000
13	Bronze	88.14	9.70	1.63	0.18	0.33	....	32,000	17,000	12.5	18.8	53.1		8,800,000
14	Bronze	88.28	10.20	2.8	trace	0.24	....	34,640	18,400	16.9	20.8	53.2		11,110,000
15	Bronze	84.81	8.4	3.00	3.58	0.06	....	28,100	16,400	11.6	15.8	58.4		5,600,000
16	Bronze	85.15	9.16	2.36	3.20	0.13	....	23,760	16,200	5.0	8.2	68.2		8,800,000
17	Bronze	83.93	11.52	1.78	2.40	0.38	trace	32,800	20,000	3.1	5.1	61.0		7,600,000
18	Bronze	86.95	9.50	2.66	0.62	0.25	....	32,100	15,620	8.8	16.4	52.6		6,400,000
19	Bronze	87.01	9.50	2.66	0.62	0.20	....	32,100	17,050	14.4	22.8	53.2		10,400,000

Ductility.

According to the order of ductility of metals, iron comes fourth, copper sixth, tin seventh, zinc eighth and lead ninth. We can apply the order of ductility to the physical results and can refer to the "reduction in area" column for the effects of the different metals on the bars. Only a few of the tests will be discussed here and the reader may form his own conclusions as to the rest.

Suppose for convenience sake we place copper as 1 in the order of ductility, then tin as 2, zinc as 3, and lead as 4, iron really ought to be placed as 1, but as iron is present in small quantities, we will look upon it as coming before copper in the course of discussion.

For the first bar we will take No. 1 and find that the analysis shows copper, 84.4 per cent; tin, 9.4 per cent; zinc, 2.42 per cent; lead, 2.64 per cent; the ultimate strength being 30,290 and the reduction in area 15.1 per cent; the elastic limit, 19,500, and the ratio between the last two or $\frac{E}{U} = 64.4$ per cent.

No. 2 bar has for copper, 82.6 per cent, tin 10.06 per cent, and zinc 7.3 per cent; the ultimate strength is 32,395; reduction in area, 15.5 per cent; elastic limit, 19,920 and $\frac{E}{U}$ 6.16 per cent. These two bars are good for comparison. The higher ultimate strength in No. 2 is evidently due to absence of lead, which fact makes up for the decrease in copper. No. 5 is a brittle bar and therefore a poor one for purposes of strength. The analysis shows high lead and an ultimate strength of only 27,100, with a reduction in area of 12.2 per cent. Another bar fully as bad as this is No. 16, its physical properties being even worse.

No. 6 is similar to No. 5 in one respect and that is ultimate strength, but dissimilar with respect to reduction in area, which runs to 20.3 per cent, an increase probably due to increase in copper, a decrease in lead with the addition of a little iron, which, as previously stated, comes fourth in the order of ductility.

No. 11 shows 81.91 copper; 10.76 tin; 4.42 zinc; 2.78 lead; 28,500 ultimate strength, and reduction in area of 7.6 per cent. This bar has a fair tensile strength for its low reduction in area, low copper and a high lead content. No. 12 has a trifle more copper, but more lead, also higher tin, lower zinc, and a little iron. The ultimate strength is 30,600, with a reduction in area of 9.2 per cent.

Nos. 16 and 17 have low reduction in area—not analyses. Two good bars are 13 and 14, both high copper and high tin, low zinc, and little or no lead, the ultimate strength being 32,000 for 13 and 34,640 for 14, and the reduction in area 18.8 per cent and 20.3 per cent, respectively. We will not discuss bars any further, but will ask the reader to form his own conclusions from the tables herein given. There are so many little points open for discussion that it seems wiser for the reader to elaborate on the data.

Conclusions.

It would appear that if the elongation in 8 inches was 20 per cent and the reduction in area 19 per cent, the bar having an elongation of 22 per cent would of course have a reduction in area of 21 per cent or so. Such is not always the case, by any means. The ratio existing between the power to stand stretching and the inherent force, or the power to withstand rupture, is a variable, depending upon the chemical structure of the bar.

A bar with a high percentage of elongation and reduction in area is not necessarily a suitable bar for all purposes, for it might be very wrong to use such a piece where high ductility is to be avoided.

There are peculiarities which enter into the test and which might well be shown in bars 18 and 19. Here are two bars evidently alike as far as the chemical analysis shows, but their physical properties vary in everything except the ultimate strength in tension. What can we infer from these bars? There surely is something which has caused the physical difference and why could it not be heat treatment? In no case has the $\frac{E}{U}$ been under 50 per cent, the ultimate strength in tension being a little less than twice the elastic limit.

Tests of Aluminum Bars.

We will offer a few tests of aluminum bars in Table III which may be compared with the bars just given. No chemical analyses were obtained, but the average aluminum content, judging from analysis of a casting from the same foundry, ought to be about 92 per cent.

The ultimate strength is very much less than that of brass or bronze bars, the elastic limit being nearly equal to the ultimate strength in 1 and 2 and equal in 3, 4 and 5, thereby making $\frac{E}{U}$ 100 per cent. No. 5 is the strongest bar, having the highest ultimate strength and the highest modulus of elasticity. It can be seen from this data that there is nothing to denote ductility about the bars, and from the fact that No. 2 has the greatest per-

centage of elongation and the least ultimate strength, we might infer that the bar had a lower aluminum content, with a fair amount of copper or tin. The writer will be glad to hear of any similar work on aluminum, and would like to hear of work that is being pursued along the line of chemical and physical tests.

Table III.

	Ultimate Strength. Per Sq. In. in Tension.	Elastic Limit.	Per cent Elongation in 8 inches.	Reduction in Area.	Modulus of Elasticity.
No. 1	13,400	11,000	1. per cent	1.4 per cent	3,600,000
No. 2	12,400	11,400	1.1 per cent	0.42 per cent	2,800,000
No. 3	16,250	16,250	0.76 per cent	0.6 per cent	4,800,000
No. 4	14,200	14,200	0.75 per cent	1.4 per cent	4,400,000
No. 5	19,000	19,000	0.5 per cent	0.5 per cent	7,200,000

$\frac{E}{U}$ for 1 — 82.1 per cent
2 — 92 per cent
3 — 100 per cent
4 — 100 per cent
5 — 100 per cent

BRASS FOUNDRY DIFFICULTIES

BY C. VICKERS

QUESTION:—I have had trouble with red brass castings made from new metal. They have hard spots but still they can be machined. When boring they are so hard that they often spring the tools. This mixture consisted of copper, 20 pounds, and zinc, 2 pounds. I also have considerable trouble in getting a good color on my castings. Sometime ago I was in a brass foundry that uses practically the same mixture as I do, but the color of my castings is not the same as the color of their product. I use Riverside molding sand and a very fine parting sand and use flour for dusting on. The foundry to which I refer uses charcoal for parting and flour for dusting, and the castings have a nice reddish color. A dip is then used to bring them to a still better color. The insides of the castings are more of a yellow than a red. Is there anything that can be put into the crucible or the sand that will bring this skin color? This foundry uses scrap brass, melting from 60 to 90 pounds to a crucible. All of my work is in green sand, as I have never used dry sand. How much lead will 50 pounds of old copper stand for making cheap castings? It is to be cast in pigs and then remelted. In giving information regarding the dip, kindly state the proportions and what kind of a dish to use.

Bad Mixture.

Answer:—The cause of your trouble lies in the mixture you are using. You imagine you are making a red brass, when in reality your alloy is a brazing metal. You are mistaken however about the hard spots, the springing of the tools in machining is not due to hard spots, but to the natural toughness of the alloy. To avoid this trouble, most brazing metals contain a small percentage of lead. This alloy is used for coppersmiths' brass work, such as pipe flanges and similar sections. It is known as brazing metal, because its melting point is higher than ordinary brass or bronze, consequently it withstands the operation of brazing without melting or crumbling away. The alloy you give is practically a standard brazing metal and is known as "ten per cent brazing." Some brazing metals contain more, some less zinc, according to the requirements of the work, and the opinion of their maker.

If your metals are free from iron, the castings should come out of the sand having the appearance of copper, and with a tendency to shrink in heavy places.

The alloy is not suitable for your work, and the people in the brass foundry you visited, must have been aware of this fact, but had some reason for deceiving you. They used scrap brass but informed you that it was "practically" the same mixture as you were using. The practically in this case meant "entirely different," and no doubt they thought it a most excellent joke.

Sand.

The fact that you use fine sand (I presume burnt sand), for parting, and they use charcoal, has nothing to do with the appearance of the castings, and there is nothing I know of that you can put into the sand to cause a golden color to appear on brazing metal castings. Such castings have a nice color of their own, or should have, provided the metal is properly mixed.

I will tell you however, what to put into the crucible:

First. To 20 pounds of copper and 2 pounds of zinc add one-half pound of tin and one pound lead, or,

Second. Copper, 20 pounds, zinc 2½ pounds, tin, ¾ pounds, lead 1 pound, or,

Third. Copper, 20 pounds, tin, one pound, zinc 3 pounds, lead 1 pound.

Or you may use two-thirds of any of the above alloys, and one-third scrap metal. Shake out the castings while hot and dip into water. Where there are cores strike the castings sharply against the side of the barrel while under water. This causes the cores to blow out, leaving nice clean castings.

Dip for Brass Work.

The ordinary dip for brass work is composed of two parts sulphuric acid, and one part aqua-fortis. The castings must be perfectly clean before dipping, or the dip will not work. After dipping rinse in clean cold water afterwards in hot water, and plunge into sawdust to dry them. I keep my dips in earthenware crocks where there is plenty ventilation.

Regarding the amount of lead to be added to 50 pounds of copper to make cheap castings I often use as high as 20 pounds. In view of your possible failure to do this however, I would recommend a yellow alloy for cheap work. A good alloy should contain copper 50 pounds, zinc 25 pounds and lead 2 pounds. Pour as rapidly as possible.

It will not be necessary to cast this alloy in pigs, or ingots, as it can be turned straight into castings.

IRON FOUNDRY OF THE HILL CLUTCH CO.

Gray Iron Plant Designed for the Production of Power Transmission Machinery Castings

A FOUNDRY building of unusual convenience, splendidly lighted and provided with transportation facilities that are unexcelled was completed in February of the present year by the Hill Clutch Co., Cleveland. The product of this company comprises clutches, pulleys, shafting and general power transmission machinery. The plant for the production of its work includes, in addition to the foundry, a shafting mill, and machine shop with the usual accessories. A new machine shop is contemplated, and the foundry plant which has just been erected was designed with a view to furnishing castings for a much larger shop than exists at present. Consequently, the present foundry is not operated to its full capacity on the regular work of the company, and considerable spare capacity exists for outside jobbing and manufacturing work. By taking in this extra work, the company aims to keep the plant full and to operate it at its maximum efficiency.

Plan of Foundry.

The foundry building, a plan of which is shown in Fig. 1, is 242 x 121 feet in dimensions. It consists of three bays. The two side bays have a flat roof, the center bay having a monitor extending entirely across the bay and is furnished with saw tooth skylights. As may be seen from the interior illustrations, the window space provided is exceedingly liberal—in fact the walls of the building consist principally of glass. As a result, the building is unusually well lighted, the ventilation is good, and it is a much more cheerful plant in which to work than the average foundry.

One of the three bays is used for pulley molding and light bench work; the center bay is used for large and heavy castings requiring pits, while the remaining side bay is used for general and medium size floor work.

The bay in which pulleys are molded is equipped with three jib cranes of about 20 feet radius, each of which is equipped with a one-ton air hoist. The center bay is provided with a 15-ton

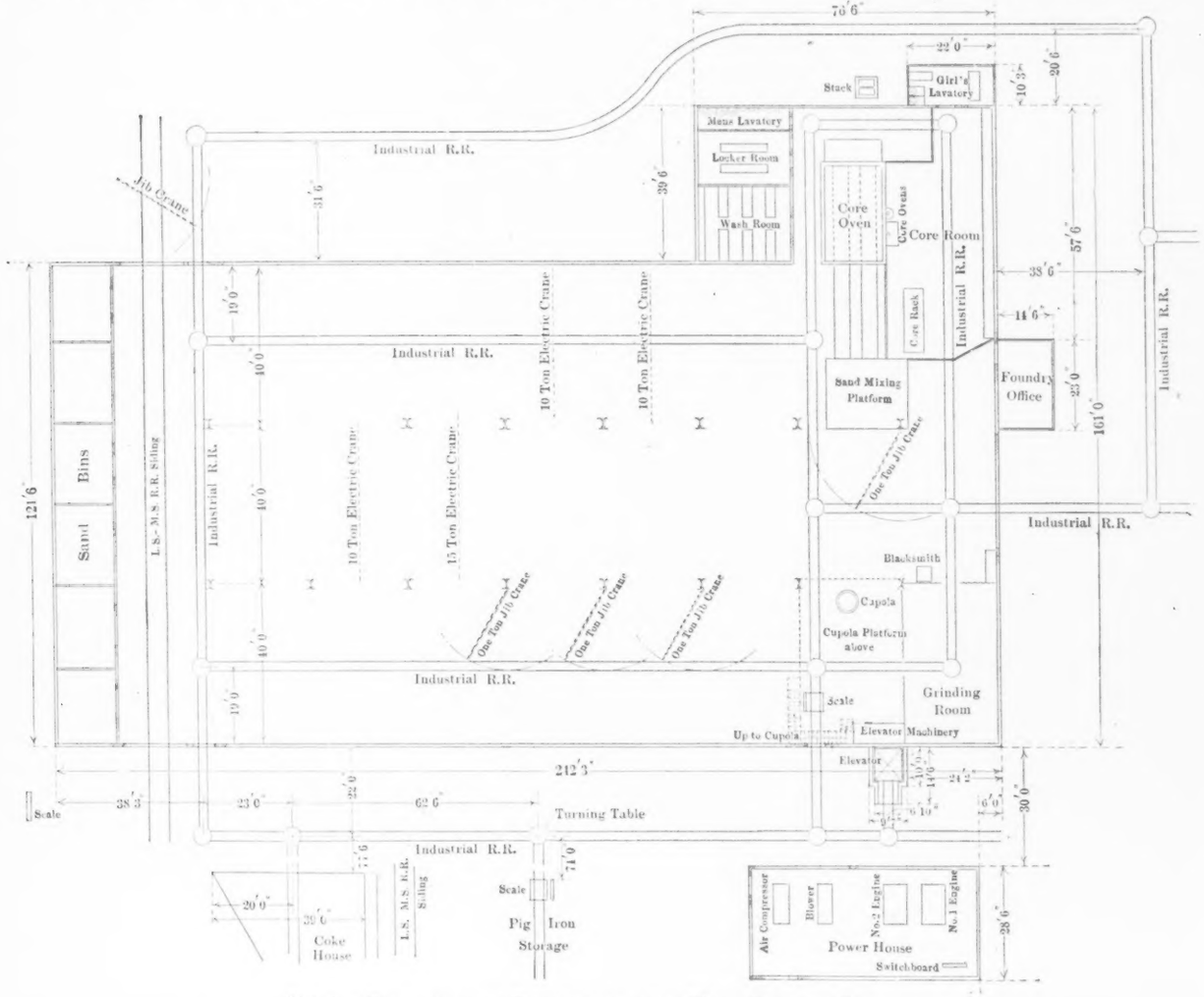
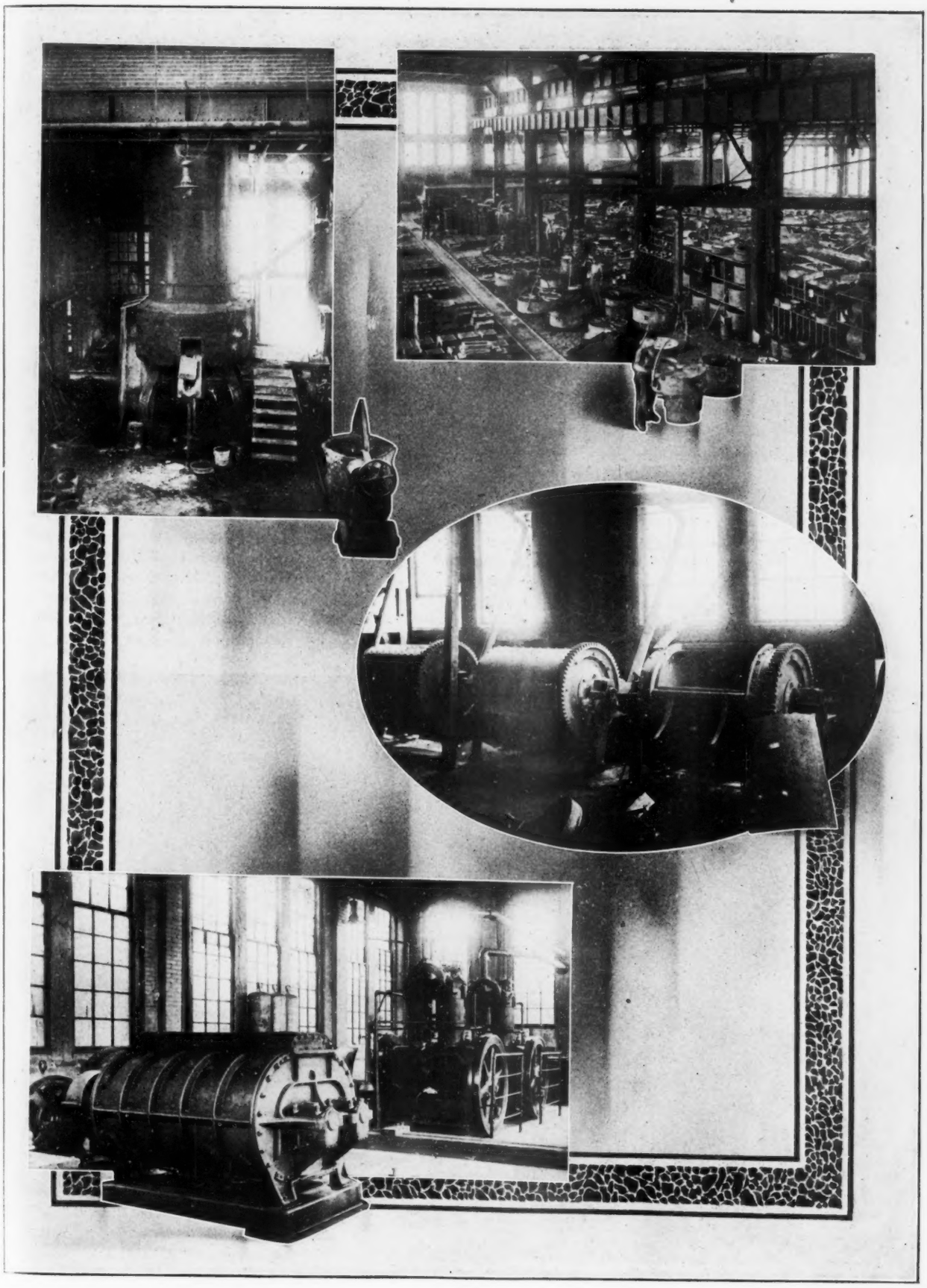


FIG. 1.—PLAN OF THE FOUNDRY OF THE HILL CLUTCH CO.



THE CUPOLA
ENGINE ROOM

FIG. 2

MACHINE MOLDING DEPARTMENT
CLEANING ROOM

FIG. 3—PULLEY MOLDING FLOOR

and a 10-ton Niles electric crane, and a jib crane at one end, while the remaining side bay is spanned by two 10-ton Niles cranes.

Industrial Track System.

The entire foundry and yard is traversed by an exceptionally complete narrow gage track system. This extends into both side bays of the foundry, into the pig iron yard, the flask storage and the pattern storage, and also completely surrounds the foundry building. This track system plays an important part in the pouring of castings, as in the two side bays, buggy ladles are used which supply hand ladles used in pouring the smaller castings. The large castings in the middle bay are poured from bull ladles carried by the cranes. A standard gage railroad track crosses the building at the far end from the cupola, being a spur from the Lake Shore & Michigan Southern railroad. Castings may be loaded directly into cars brought into the foundry building and transferred to the machine shop, or shipped to outside customers. A second standard gage track extends across the outer side of the building, being connected to the one inside the building. On this second track is a 125-ton track scale.

Four sand bins are located at the end of the foundry alongside the standard gage track. These communicate with the foundry through large doorways through which the sand is shoveled directly from the cars on the standard gage track. The bins being under cover and warmed from the foundry, the sand is in good condition at all times. A sand mixer is installed on a platform at the opposite end of the foundry, the platform being clearly visible in the view of the core room, being erected directly behind the double core bench. The sand from the bins is loaded on wheelbarrows

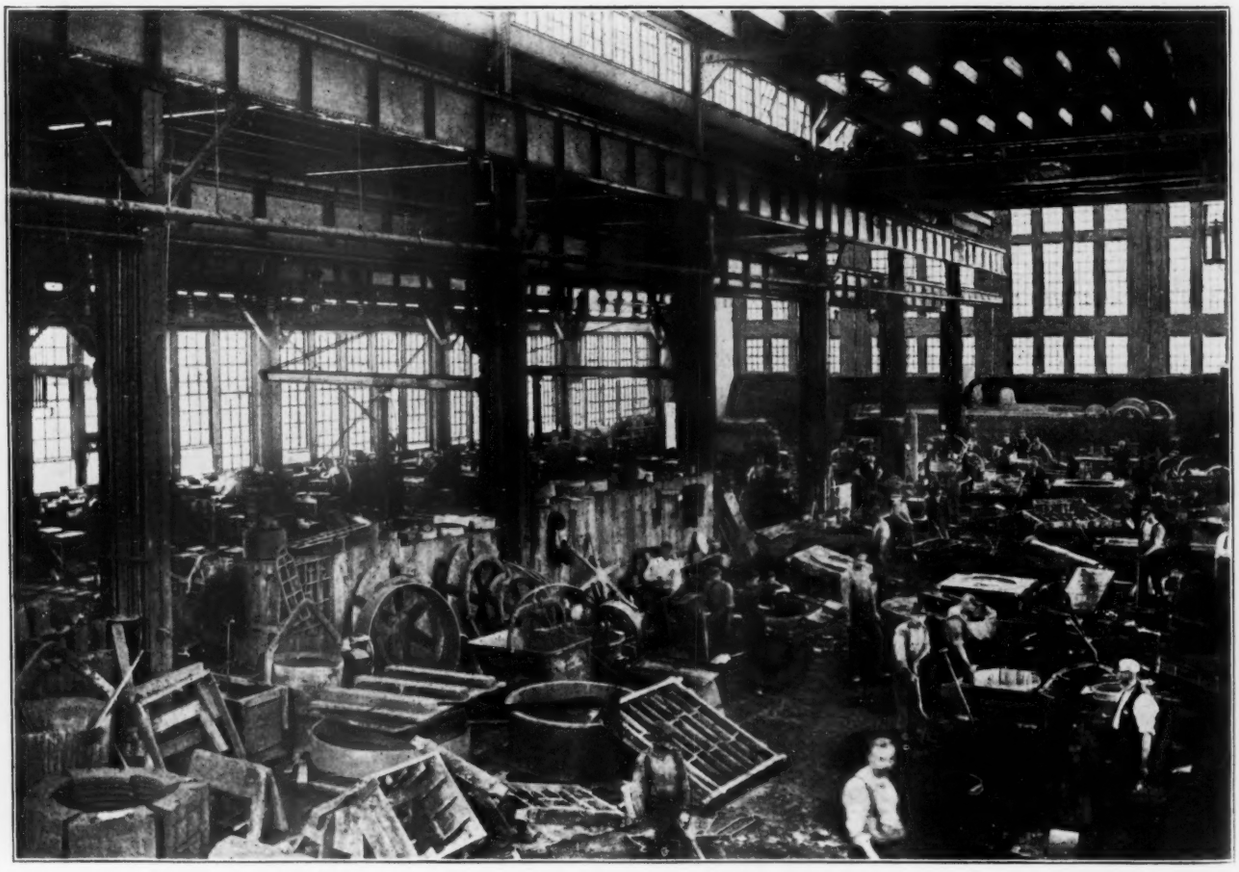


FIG. 4—MIDDLE BAY OF THE FOUNDRY

and picked up by one of the cranes and transported directly to the sand mixer. The sand mixer delivers to two chutes, one of which leads to the core room and the other to the general foundry.

Iron Storage.

The pig iron yard is large and well arranged and is served by both standard and narrow gage tracks. A track scale is placed on the narrow gage track, being roofed over and provided with a number of beams, so that mixing of the cupola charges can be effected directly on the scale car. Adjoining the pig iron yard is the coke storage, which is a covered building also reached by the narrow gage track system. The flask storage is located at one end of the foundry, ample space being provided for this purpose. A fire proof pattern storage has also been built. It is of brick construction and is divided into four sections by heavy fire walls.

FIG. 5 —CORE DEPARTMENT

In the pulley molding department a large number of molding machines have been installed including four Walker machines for pulley molding, two Tabor pneumatic machines, two Tabor rockover machines, one Pridmore stripping plate and one Berkshire machine. The company has recently copmleted from its own design a 48-inch pulley molding machine, and has under construction two more machines of 60 and 72 inches capacity, respectively, thus enabling it to turn out machine molded pulleys of unusually large size. The illustration, Fig. 3, shows one of the pulley molding machines commanded by a jib crane air hoist. Pneumatic rammers are used on the larger molds, which are made in the center bay.

FIG. 6 —ONE OF THE SIDE BAYS

Melting Equipment.

Metal is melted in a 72-inch Whiting cupola situated at one end of the foundry, in a line with the columns dividing the center from the pulley molding bay. This cupola is provided with two spouts at right angles to each other, so that it can pour into the two bays immediately adjoining it. The charging platform is reached by a Craig-Ridgway steam hydraulic elevator, which is operated, however, by air instead of steam. The charging platform is provided with a narrow gage track completely surounding the room, permitting the rapid handling of material. Blast is provided by a No. 6 motor driven blower, located in the power house adjoining the plant.

Core Room.

The core room is situated at one end of the foundry, at one side, the opposite corner of the building being taken up by the cleaning room. A single bench and two double benches comprise the equipment of the core room, together with two core ovens, fired with coke. The completed cores are loaded on cars which run into the ovens. The front of the ovens is closed by a rolling shutter door. In an extension built at one side of the core room, a number of female core makers are employed. The company's reasons for employing female help in this department are that girls are naturally quicker than men; are more amenable to discipline and can be obtained cheaper.

Cleaning Department.

The cleaning room contains four rumblers and two grinding machines. A sand blast will eventually be installed. The rumblers and grinders are driven from a line shaft extending across the lower end of the foundry. This shaft also drives the sand mixing machine by means of a chain belt. Situated alongside the core ovens, are two brass cupolas, each with a capacity of about 600 pounds per day. Immediately behind the core rooms and in an extension are installed a lavatory, toilet room and locker room. These rooms are all clean and well kept, expanded metal lockers being provided for the men's clothing.

An unusual feature in connection with this foundry is the removal of all power generating and blowing machinery to the power house. The location of this power house is clearly indicated in the plan, Fig. 1. It is a building 59 x 28½ feet in dimensions and contains the following equipment:

Two 75-horsepower Rathbun gas engines, each direct connected to a 45-kilowatt, 220-volt, direct-current generator; a No. 6 Root blower for providing wind for the cupola, this being driven by a 40-horsepower motor geared to it and a cross compound Ingersoll-Sargent motor-driven air compressor, driven by a 60-horsepower motor geared to it. Another auxiliary building operated in connection with the foundry is a flask shop, situated some distance behind the power house. About 200 men are employed in the foundry at present.

METALS IN FOUNDRY PRACTICE

Questions from Practical Foundrymen are answered in this department by the following experts

CAST IRON	W. J. KEEP
MALLEABLE IRON	DR. RICHARD MOLDENKE
METALLURGY OF STEEL	J. B. NAU
STEEL CASTINGS	W. M. CARR

OTHER EXPERTS ALSO CONTRIBUTE **ADDRESS ALL INQUIRIES TO THE EDITOR**

CAST IRON NOTES

BY W. J. KEEP

QUESTION:—Can you give me any information regarding cupolas having a receiver in front into which the iron runs as fast as melted? Is this used in this country in any of the jobbing foundries and is any difficulty experienced in keeping the iron hot enough for small work? In the drawing shown herewith, WW is the wind box, SS the sand bottom, T the tap hole, and spout to the ladles, OO the open discharge and spout from the cupola, P the peek-hole opposite OO, Z the slag spout at any convenient place, and XX the tuyeres.

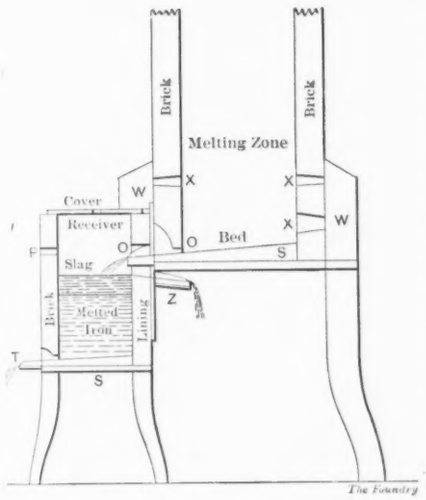
Answer:—Iron is of better quality if drown from the cupola as fast as it is melted. Holding it in the hearth of the cupola causes it to absorb sulphur from the fuel. The receiver shown is an ideal arrangement. The tuyeres are located close to the sand bottom, therefore there is no large bed of fuel, as in the ordinary cupola, and this would give you a much better fuel ratio. As the iron and slag run out as fast as melted, there will be very little danger of slag chilling in front of the tuyeres, and for this reason for long heats or for continuous melting, this is a very good arrangement.

There would be little danger of the bottom cutting through and if it did, repairs would be simple, as there would be no weight of molten iron to run through the hole. The receiver could be arranged with rollers on the legs so that it could be taken away when not in use. As the receiver would contain no coke it would hold a large quantity of iron. The lining should be thick enough to keep the iron hot. A fire should be built in the receiver the same as in the cupola to heat it white hot before the iron would be run into it. The ashes and charcoal would float on the melted slag, or would run out of the slag spout. The melted iron in the receiver would be covered with slag, and the loose cover on top, with the heated lining, would probably hold the heat so as to make the iron fully as hot as in the hearth of the ordinary type of cupola, in which the cold blast has a tendency to cool the slag and iron after it drops below the melting point.

The iron in the receiver covered with slag would permit all dirt to rise to the top and cleaner iron would be secured than if drawn directly from the cupola. Small or large quantities of iron could be taken from the tap spout, or the tapping hole could be made of a size to cause a continuous stream of iron to flow throughout the heat.

If I am not mistaken a modification of this arrangement is used in the new

foundry of Warden King & Son, Montreal, Canada. I do not recall any other. At the Osborn Works, Auburn, N. Y., the spout is constructed in such a way that the dam is formed a little in front of the tapping hole. The slag is stopped by the dam and flows over the side of the spout through a notch and is caught and taken away in a wheelbarrow. The iron flows under the dam and no slag can flow into the ladles. Nearly all car wheel foundries and many plants doing large work have the cupola placed on high legs, and the iron runs out as fast as it is melted into a large mixing ladle hung on trunions which is located just beneath the spout. This receiving or mixing ladle has a



RECEIVER FOR MOLTEN IRON

heavy lining which is heated before the iron is run into it. The slag is tapped at the back of the cupola and is not expected to run out of the tap hole.

A receiver of this kind generally holds from one-half a ton up to several tons of melted iron, and such a large body will retain its heat for a considerable period. The iron is clean and is of uniform quality. When filling small ladles the receiver is generally tilted to permit the iron to run out over the upper edge. In some mixing ladles the iron is tapped at the side near the bottom, but it is not customary to place a cover on top to retain the heat. These ladle receivers are occasionally filled and lifted to one side while another is filled and so on until enough iron is melted to pour the largest casting. The mixing ladle is used primarily to obtain a uniform quality of iron. Iron in the ladle can be treated with ferro-manganese, or with aluminum and when castings are poured the quality will be much more uniform than if poured from iron caught directly from the cupola in several ladles.

The receiver shown is often used in England and Germany to soften iron for small castings by throwing charcoal into it before the iron is caught and permitting it to remain on top of the iron. Such a receiver permits a large quantity of iron to be melted in a small cupola.

ONLY ONE BRAND OF IRON.

Question:—Why are several brands of iron mixed? Why not purchase one iron exactly suited for the work required?

Answer:—In the first place, it is practically impossible to secure a single iron that can be depended upon to produce a given quality of castings. It must be a little softer or the grain must be varied to suit the requirements, and the only practical way is to mix another iron with it. It is cheaper to use ordinary iron which can be readily purchased and then change it to what is required than to hold a furnace to a close specification. It is best to use iron from at least four furnaces not counting your gray silveries, and by this I mean not four brands from one furnace. If one stack is closed down for repairs, or if the furnace is not making the iron desired, another brand could be purchased temporarily or the proportions of the brands left in your yard could be varied without greatly disarranging the mixture. If a mixture is made of only two dissimilar irons and you are short of the one brand on which you depend for quality, it is not always convenient to find a substitute.

FOAMING OF SLAG IN THE CUPOLA.

Question:—We have been troubled considerably recently by frothing in the cupola. One day the slag went nearly to the charging door. Since that time it has not been so bad, but we would like to find a remedy for it.

Answer:—The foaming of slag is somewhat of a mystery to foundrymen, as the cupola will operate well for weeks and months at a time, and suddenly the slag will begin to boil and foam, sometimes mounting to the charging door and flowing over on the floor. At the same time a bright white flame can be seen coming from the cupola stack and clouds of reddish brown smoke will float away into the air. Frequently the results of foaming are harmless, although there is always a serious loss in the amount of melted iron. When the iron suffers, however, castings will be found to be hard and brittle and in some instances the thinner castings become white. If the foaming slag is analyzed, the iron will be found to be in an oxidized condition. The large amount of oxidized iron in the slag, which frequently ranges from 12 to 30 per cent, indicates that the iron is being rapidly burned in the cupola. The low silicon, carbon and manganese in the castings show that these elements have likewise been burned out. The unusual burning of the iron is probably due to insufficient carbon in the fuel for the amount of air in the blast. The foaming generally accompanies light, poor coke and a heavy blast. In some cases this foaming is greater when the coke is wet. To avoid foaming, the blast may be reduced if it is possible to melt slowly, and if this cannot be done, then the pressure may be continued, but the coke should be increased. The evil effects of boiling may be cured by adding finely crushed metal and ferro-manganese to the stream of iron as it runs from the spout. Occasionally an insufficient amount of limestone is also used, and a simple calculation for figuring the charge is as follows: With clean iron, use 20 pounds of limestone with every 100 pounds of coke; with sandy iron, use 25 pounds of limestone with every 100 pounds of coke.

A. C. B.

LIGHT ALUMINUM ALLOYS.*

BY J. E. STACEY JONES

Aluminum is not used for technical work, as in motor-car construction, in a pure state, as its strength is not sufficiently great. The light alloys of aluminum, in contradistinction to aluminum brasses and bronzes, etc., may be divided into two classes for convenience:

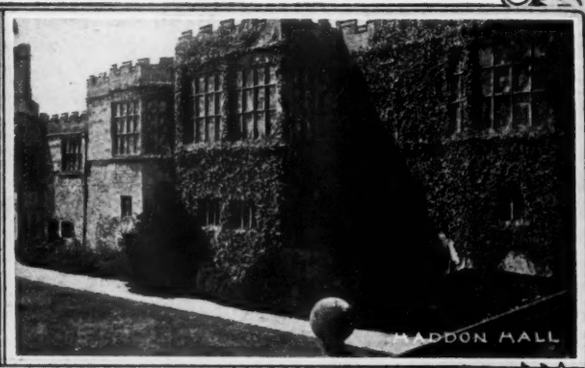
(1) Alloys of aluminum, copper, and zinc, in various proportions.

(2) Alloys of aluminum with such metals as tungsten, nickel, manganese, silicon, antimony, titanium, chromium and silver, with or without either or both copper and zinc.

Copper-zinc alloys generally contain about 2.5 per cent of copper, 85 to 95 per cent of aluminum, and the remainder zinc. In ordinary sand castings it is difficult to get more than 12 tons tensile strength, unless they are water-chilled. If cast in metal molds their strength is also increased.

In tungsten alloys, such as wolframinium, it has been found that a fraction of 1 per cent of this element makes metal for tubes, sheets, strips, etc., much stronger, and increases the resistance to corrosion. It also renders the alloy able to be spun, drawn, or rolled well, and antimony gives good casting properties. This alloy has a specific gravity of 2.75 and contains about 0.1 per cent of tungsten.

*From a paper read at a recent meeting of the Coventry Engineering Society.



ANNUAL MEETING OF THE BRITISH FOUNDRYMEN'S ASSOCIATION

BY J. HORTON, STAFF CORRESPONDENT

THE annual convention of the British Foundrymen's Association was held at Sheffield, England, August 6, 7 and 8. The meetings were held on the mornings of the first two days in the auditorium of the department of applied science in the university, and during the afternoon of the first two days and the whole of the third day, visits were made to some of the largest establishments in the immediate vicinity, as well as to some of the charming rural resorts. The attendance was larger than at any previous gathering, 85 members being present, while civic recognition of the gathering was extended by the Lord Mayor of Sheffield and the Master Cutler.

The president, Herbert Pilkington, in opening the meeting, expressed his pleasure that it was to take place in Sheffield, in the vicinity of his home. He said that the entertainment committee had put forth its best efforts to entertain the visitors, and while the number of papers was not as large as desirable, nevertheless, several interesting addresses had been provided.

Secretary's Report.

The secretary, F. W. Finch, then read his annual report, which showed gratifying progress in point of membership since the last convention, and the financial report was extremely satisfactory. A year ago 169 ordinary members were enrolled and five life honorary members. At present the society has 245 paying members in addition to the five honorary. Ninety-seven new members were enrolled during the year, consisting of eighty-two ordinary members, and fifteen that contributed a guinea each to the cause. Since January, seven honorary and sixty-two ordinary members were admitted to the society. Two members, John Butler, of Messrs. Evans & Co., Manchester, and W. H. Richards, of Darlaston, died during the year. The secretary reported that the branches have been doing excellent educational work and have secured many members for the association. President Herbert Pilkington read several papers before the Birmingham and Manchester branches, and the vice president, F. J. Cooke, before the Cardiff and Birmingham locals. Percy Longmuir also read a number of papers before these societies. The council held four meetings during the year and at the March gathering three places were named for the convention, Sheffield being selected.

Distribution of Circulars.

During the year, 1,000 circulars were sent to employers, inviting them to become honorary members and to assist the council in the work of educating foundrymen along scientific lines. Eight joined last year and seven thus far this year. One of these was Stanley G. Flagg Jr., who was recently elected president of the American Foundrymen's Association.

The election of officers was next in order and Herbert Pilkington was nominated for re-election to the presidency. He was chosen without opposition. F. J. Cooke and Percy Longmuir were elected vice presidents. The following members were elected to fill the five vacancies in the council: R. W. Kenyon, Accrington; S. A. Grimson, Leicester; J. Oswald Jr., London; P. Munnoch, Middlesbrough. Owing to his many other outside duties, the secretary, F. W. Finch, refused to have his name put in nomination and J. E. H. Allbut was elected his successor.

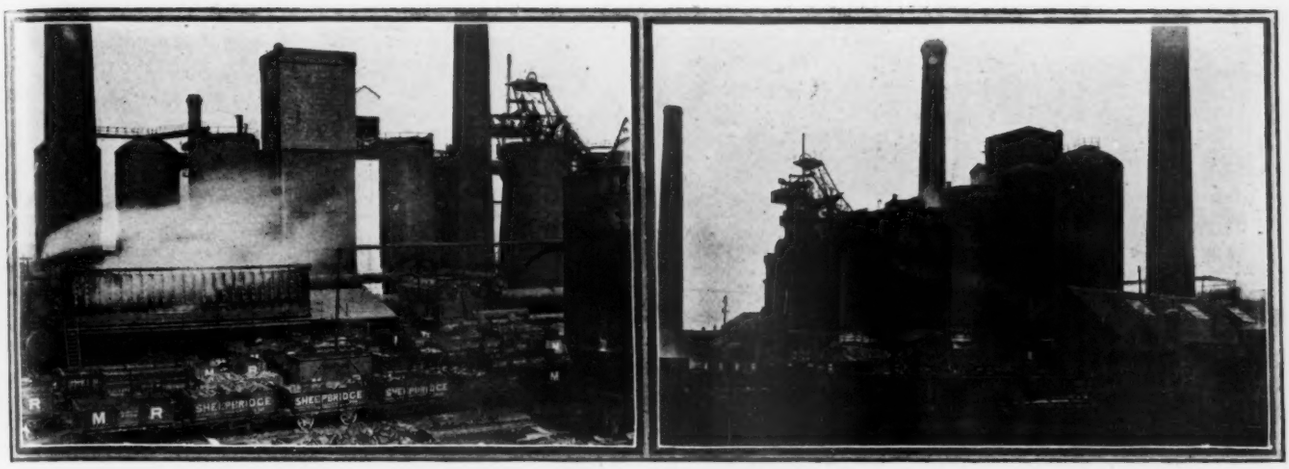
The routine business was then interrupted for the purpose of listening to the addresses of welcome from the Lord Mayor and the Master Cutler.

Address of Welcome.

The Lord Mayor, who was received with applause, spoke as follows:

"My first duty is a very pleasant one, and it is to bid your association a very hearty welcome to the City of Sheffield. I believe this is the first time you have met here, and we are very glad indeed to welcome you. Although Sheffield is not the center, and cannot fairly be considered as the center of the ironfounding industry, we are, as everyone must know, very closely and very intimately connected with everything that affects the iron industry in all its branches. In regard to certain particular branches such as heavy castings for anvils and anvil blocks, I suppose there is no place in the world where castings of a larger character are sent out. Apart from that, we have not any particularly large concern engaged exclusively in iron founding. Of course, while this may be so, so far as Sheffield itself is concerned, in the immediate neighborhood there are concerns of the greatest importance. At Sheepbridge, where your president is so largely interested, at Stavely and at Stanton, ironfounding is carried on in its greatest magnitude.

"Speaking of those three places, leads one more particularly to think of iron founding in connection with the great pipe industry. It fell to my lot only a few days ago to see some of the original apparatus con-



BLAST FURNACES OF THE SHEEPBRIDGE COAL & IRON CO., LTD., NEAR SHEFFIELD, VISITED BY THE MEMBERS OF THE BRITISH FOUNDRYMEN'S ASSOCIATION.

nected with the conveyance of water for the supply of large centers of population. I saw taken up and stored carefully in the museum some old wooden pipe which was formerly the only means of conveying water underground. It was taken through wooden blocks of elm, which were bored out to a diameter of 3 or 4 inches, and these, up to comparatively recent times, formed the only means by which water could be conveyed underground. Now we see the results of this development, so that we think nothing of conveying water in iron pipe, 40, 42, and as high as 45 inches in diameter. Of course, you would have a large claim upon the interests of the City of Sheffield in association with that of other large towns, if you were concerned in nothing else than the production of pipe of this character.

"We all recognize that we are under a great debt of obligation to the iron foundry industry in this connection. Personally, I have some interest in the matter, inasmuch as in a public capacity I have been concerned in placing large orders for iron pipe in connection with our recent undertaking at Sheffield, in the extension of our water works at Langsett Valley. We have placed orders for iron pipe to the extent of 19,000 tons. In connection with the Derwent Valley scheme, we have placed orders for iron pipe of large diameter to the enormous extent of 154,000 tons.

Study of Foundry Practice.

"In Sheffield we have done and are doing our share towards developing the industry in which you are so much concerned and interested. In this particular building, the Applied Art Section of our university, great care and attention is given to the development of the examination and study of iron and steel founding in all its branches. We know perfectly well how important it has become that these questions in connection with the iron founding industry should be studied in a scientific manner. Up to comparatively recent times, it was the usual experience in connection with iron founding, as it certainly was in connection with steel making, that practically all the processes were carried out by rule of thumb. Now we know perfectly well that entirely different methods have been adopted, and the scientific method has been introduced with the greatest possible advantage to the industry itself.

Steel Foundry Practice.

"Now, if this is true of iron, it is infinitely more so of steel founding, which is becoming a very important section of the operations in which your society takes an interest. Of course, in connection with steel founding, one cannot in Sheffield speak of that rapidly extending industry without some reference to the brilliant work which has been done by our townsman, R. A. Hadfield. I suppose he has done more for the steel founding industry than perhaps was ever done by any single individual in connection with that large industry.

"One most interesting feature both in connection with the development of water supply and tramway undertakings, is that, immediately the demand has arisen for great advances, the difficulties which beforehand were thought to be insurmountable have been overcome, and the supply has been produced to meet the demand. It shows us in regard to the two matters of which I have spoken, how large a field there is open for your industry.

"I don't suppose any of you who gives consideration to the subject at all, has come to the conclusion that you have reached the ultimate limits of what is possible in connection with the iron and steel industry. I am quite certain that those who take a wide view of the subject must have concluded that there is still an immense future before you. I think everyone must be satisfied that the hope of the future lies in the development of scientific methods. Scientific methods have already led to the use of ores, previously thought to be altogether unsuitable and impracticable for a particular purpose, and they have enabled the very satisfactory result of which I have spoken to be attained."

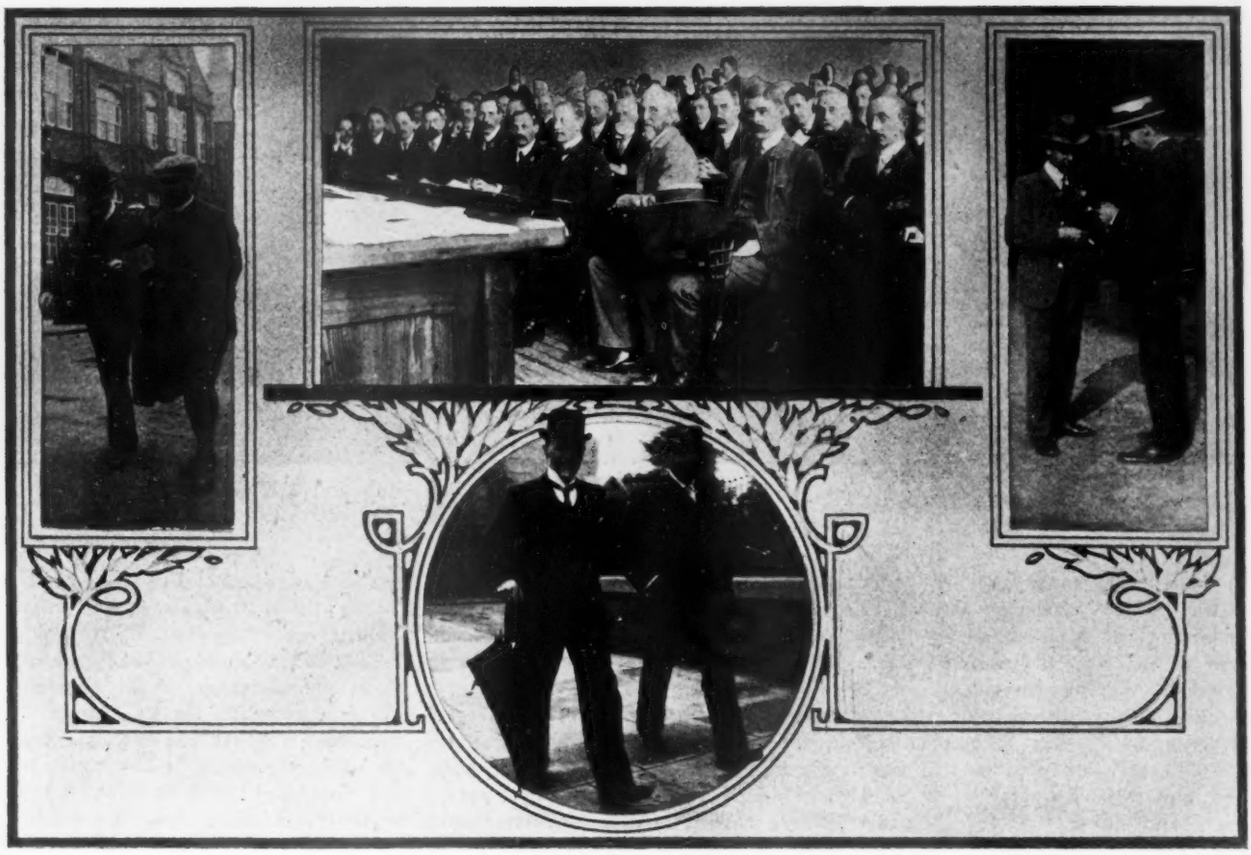
The Master Cutler also offered a few words of welcome, remarking that the Lord Mayor had greeted them from the civic point of view. Personally, he could claim to welcome them more from the commercial point of view.

Presidential Address.

The president then delivered the following address:

"In welcoming the association to Sheffield I must first of all express my appreciation of the honor done me by electing me your president for a second year, and that on the occasion of the visit of the association to my district. The association whose prosperity we all have at heart, has continued to increase in both membership and influence until we now number 250 members, and it is clear that this figure will soon be doubled.

"It has been stated by the president of the American Foundrymen's



INCIDENTS OF THE SHEFFIELD CONVENTION
MEMBERS IN CONFERENCE
A. HUNTER AND ROBERT BUCHANAN
HERBERT PILKINGTON AND G. ADAMSON F. J. COOKE AND PERCY LONGMUIR

Association that the progress of the foundry trade in America has dated from the time of the formation of their association and is due to the educational influence exercised among all classes of foundrymen in all classes of work there. I take it that it is also our ambition to become in like manner, the most powerful educational influence among the foundrymen of this country; it is clear to everyone at any rate, that we have laid a most solid foundation upon which to build the superstructures I have indicated.

Visits to Allied Associations.

"I have visited the branch associations at Birmingham and Manchester, but unfortunately was unable to do so at Cardiff. I am pleased to say that the three branch associations are exhibiting remarkable vitality and prosperity. I am hoping that this meeting will be the means of the formation of a local branch association in this city.

"Although the average man dislikes the advice or even the example of the schoolmaster, it may not be out of place to remind the foundrymen belonging to this association, as this university does, that there are other aspects of education than mere metallurgical work. I should like to see the members deal with subjects in their papers not only metallurgically but from every aspect of the foundrymen's art.

Home of the Steel Casting Industry.

"Sheffield is the home of the steel trade, and what is more directly interesting to us as foundrymen, the home of steel castings and the members will be afforded an opportunity of seeing some of those magnificent works of which Sheffield is so justly proud. In this city, steel castings of every type are made, crucible Siemen's, and Bessemer castings, and there is no city in this country, or any other, so far as I know, where this industry is so large and so deeply rooted.

"I have learned that many of the members of our Birmingham branch, since a speech I made at another institution in their district, have described me as a pessimist with regard to the iron and steel industry of this country, a criticism which is not well founded, inasmuch as the charge is a somewhat mistaken one. In particular I am not a pessimist with regard to our foundry trade, neither are any of us pessimists on this point in the Sheffield district. I believe the foundry trade of this country, iron, malleable and steel, has a great future before it. This country is a great engineering country, and what with its developments in mechanical engineering, construction work, engine building, and shipbuilding, I can only see a large and increasing prosperity in foundry work before it. What I am pessimistic about, if the spirit of criticism is pessimism, which I take leave to doubt, is the antiquated methods and the antiquated spirit with which we for the most part deal with the manufacture of castings of all kinds.

"It appears to me, however, that although there are many excellent exceptions, there is no department in our great iron and steel trades which is so antiquated, not only in commercial methods, mechanical arrangements, in systematic organization and scientific methods as that of the ordinary foundry industry. What we want to do in the foundries of this country is to "Wake up," and it is

PRESIDENT HERBERT PILKINGTON AND MEMBERS OF THE COUNCIL OF THE BRITISH FOUNDRYMEN'S ASSOCIATION

the duty of associations, such as ours, to awaken them by such criticisms and teaching as we are capable of.

"Although we export many thousands of tons per annum of foundry pig iron to Germany, and other parts of the continent, yet it is clear that in Germany alone they make something like double the amount of iron castings that we do, and, although there are no direct statistics available in this country as far as I know, with regard to the productions of castings of any sort, yet the ordinary iron castings cannot exceed an output of more than one and one-half millions of tons per annum. This is a very small output for a country like ours. It is however of foundry methods that I desire to speak more particularly.

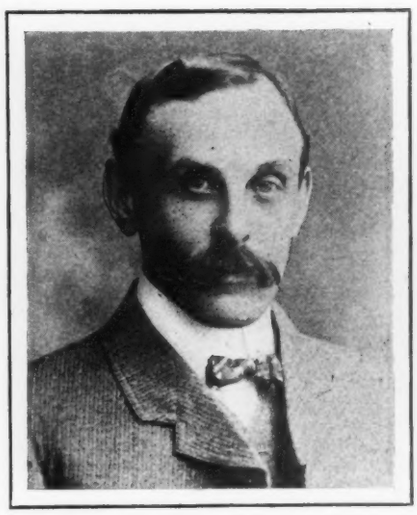
"It has frequently been said in this country by those who are well able to judge, that if one sends to six different firms of founders for tenders for any line of castings, that one would never fail to get one tender out of the six at such a price that the castings could not fail to be made at something less than the cost of production; that is to say, at a loss.

Production Costs.

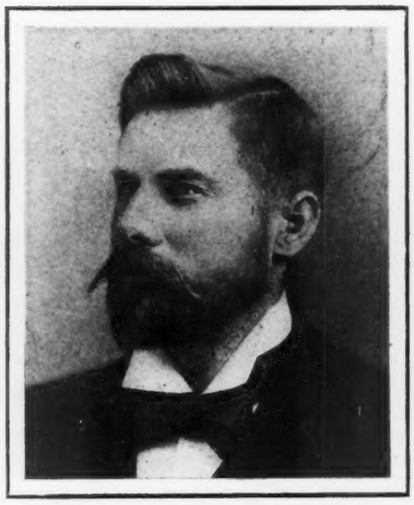
"There is no doubt whatever that there is a grave element of truth in this statement, and it clearly shows that here, as well as in some other countries, for we are not peculiar in this respect, the organization and perfection of cost keeping methods are in a very unsatisfactory condition so far as castings are concerned. In these days of specialization in the manufacture of products of all kinds, there is no place where systematic organization and specialization is more distinctly necessary than in the foundry. The ordinary jobbing foundry often attempts all sorts of castings, whether suitable or otherwise for it, due, the foundry manager often asserts, to the layman who controls him and his foundry. Its products are therefore so miscellaneous that it is generally hopelessly confused with regard to the detailed cost of its production, and therefore is not in position to properly estimate the cost of any particular class of work.

"The ironfounder in such cases cannot therefore make out a tender based upon previous experience, except in the most empirical and crude manner. Since I have been president of this association I have frequently heard from many members of it, in ordinary conversation, the assertion that the ordinary foundry managers as a rule, owing to the organization at their particular works, have not the opportunity to acquire knowledge on this subject, inasmuch as it is dealt with by either managers or officers who may or may not be their superiors, but who are themselves laymen in the foundry business.

"There is, doubtless, a certain amount of truth in this assertion, as it frequently happens that there is in particular cases a good deal too much layman control about foundry operations. But after all the first element in costkeeping of any importance, is within the foundry organization itself, and I have found it always difficult to get the debts and appropriations inside the shops themselves properly dealt with. It is manifest that if a shop, or to go to a



F. J. COOKE
Vice president, British Foundrymen's Assn.



HERBERT PILKINGTON
President, British Foundrymen's Assn.

J. E. H. ALLBUT
Secretary, British Foundrymen's Assn.

larger unit, a whole foundry is working producing one class of goods all the time of a similar weight and character that costkeeping in such a case is simplicity itself, but even in the case of large specialized foundries making, for instance, cast iron pipe, in which different weights and sizes may be made in separate but adjacent shops, it is not easy without intelligent management to regularly and properly distribute charges to the different and varying weights and sizes of pipe.

"If it requires a careful organization in foundries on special lines of work, it is therefore clear how much more so it is requisite if the ordinary jobbing shop or general foundry be taken, which is on varying work of a very different character. The system has to be an extremely elaborate one, well thought out, to get the exact cost of each of the different jobs at different classes of castings produced, which can be the only correct system to use to form an accurate basis for sending in proper tenders for work. It is the practical foundry manager who will have to not only successfully carry this out but improve and elaborate on it in all its details. I should like the members to set to work and give papers on this most important subject. It is clearly one which will require much patient investigation and the foundry requires the gradual application of improved methods with regard to it.

Foundry Losses.

"There are other matters of organized system in foundry operations which deserve attention. Wasters for instance are the cause of much misplaced energy not to say language, in all foundries, and it seems to me that in most foundries these wasters might be very much diminished by an organized study of them. It is frequently said that the study of errors points out the way to success in the future, and it can be said with certainty that a study of wasters made, is the surest way to their reduction in quantity in the future; therefore a systematic manner of dealing with the subject of wasters is highly necessary in every foundry. A proper waster book should be kept, and every waster recorded and the number or name of those who made it, together with its type, the cause of its production, or the particulars of any investigation made with regard to it. The number or percentage of wasters produced in every class of work would then be accurately known. The percentage production of every type of waster would also be known. Gradually, a mass of valuable statistics would be accumulated and any fluctuation in them would be keenly noted and studied and efforts made to remove the cause of them. In no instance, would the use and study of statistics carefully compiled be better rewarded.

Record of Equipment.

"There is still further another practical matter in the ordinary operations of a foundry which requires systematic attention, and that is the proper registration of all the costly tackle used, such as boxes, core bars and the various other loose equipment. It is just as necessary to provide a system for the quick registering and finding of stored foundry tackle, as it is to so provide for the drawings in a drawing office or the patterns in a pattern store. These classified registers not only provide quick information with regard to the actual possession of certain tackle which will be suitable for the specific jobs wanted, as to the quantity or suitability or otherwise; but they form the basis of a ledger account for debiting the cost of new tackle, or for the crediting of scrap from broken up tackle, and therefore furnishing the actual cost of such plant on each or any class of castings with systematic and unerring accuracy.

Metallurgy of Cast Iron.

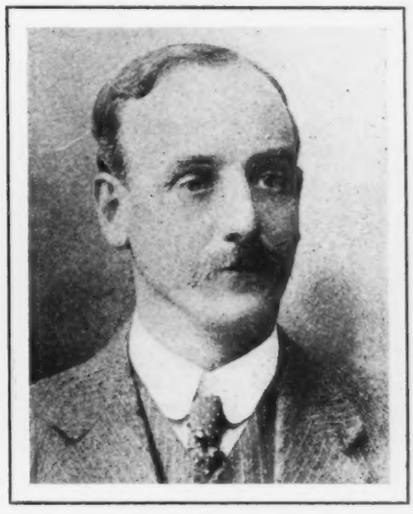
"Perhaps the greatest advance made in this country with regard to foundry work, particularly iron founding, has been the increased attention paid

HERBERT PILKINGTON

Herbert Pilkington, president of the British Foundrymen's Association, takes rank among the captains of the British iron industry. He was born in 1863, and was educated at Whitfield, and the Manchester Technical School. He started his career in the iron and steel trades in 1879, when he joined the Outwood Iron Co., Ltd., of which works he subsequently became manager. Between 1884 and 1889 he occupied the position of manager and engineer to Roberts & Co., of Tipton, during which period he reconstructed the plant. Between 1890 and 1893 he remodeled, in his capacity of ironworks manager, the works of the Midland Coal & Coke Co., Ltd. He subsequently went to Wellingborough Iron Works as general works manager, and afterwards in 1897 to the Sheepbridge Coal & Iron Co., Ltd., near Chesterfield, where he installed, as long ago as 1900, an electric power plant operated by blast furnace gas engines. At the Sheepbridge Co.'s works Mr. Pilkington also installed the first mechanically charged blast furnace in Great Britain. He also designed and erected a pipe foundry, electrically operated, with a capacity of 500 tons of pipe per week. He is president of the South Staffordshire Institute of Iron and Steel Works Managers, and is a member of the Iron and Steel Institute, and also the British and American Institutes of Mining Engineers.

R. MASON
Member Council, British Foundrymen's Assn.

CHARLES JONES
Member Council, British Foundrymen's Assn.



J. ELLIS
Member Council, British Foundrymen's Assn.

to the study of the metallurgy of cast iron. I think there is an immense amount of work yet to be done with regard to the metallurgy of cast iron as contrasted with steel; but it is a good omen for the future that so much has already been done, and that not only has a large amount of research work been accomplished, but a great deal is now in progress.

The advent of the chemist or metallurgist in the foundry has not in every case been immediately productive of better results, owing to the fact that the metallurgist has first of all to study the circumstances and conditions obtaining, but more frequently because it is a long time before the foundry manager or foremen are able to appreciate his work. Every foundry manager ought to become a student of metallurgy, to enable him to apply the work of the metallurgist in a systematic and practical way in the foundry.

Testing.

"There is another subject which in my opinion we shall shortly have to make up our minds about, and that is with regard to the inspection and the testing of castings. It is true that of late years in one material or another the engineering standards committee has dealt with these matters in a very efficient manner; but it is only latterly that materials made of cast iron have been under consideration. It is perhaps desirable that I should say here that I have recently been put upon the particular committee which deals with cast iron pipe. There is, and always has been, a considerable divergence of opinion with regard to the particular tests which should be imposed on particular kinds of castings, and the metal of which they are composed, and frequently the tests imposed are not compatible with each other. I consider that in the near future, we, as an association, must go carefully into this question, because it is quite clear that in our collective capacity we shall probably be able to furnish the most practical and scientific opinion on these tests of any organization in this country.

"In conclusion I may say that in pointing out a few of the defects existing in foundry system and organization I am quite well aware that there exist many foundries above criticism and reproach, and during the last few years we have made immense strides in the direction of improvements in these matters."

R. Buchanan, commenting on the president's address, said that question of costs had been greatly neglected and there were hundreds of foundries that did not pretend to have anything but the haziest ideas as to what their product cost. They looked with the greatest surprise when they found that the banking account had dried up, and they had nothing to pay their creditors with. That was not a fancy picture, but something of which they heard every month. In regard to some foundries, it was not difficult to predict where they would ultimately land. Meanwhile that was an enormous drawback which hindered the man who did know his business from getting the price he ought to get.

Percy Longmuir, Carnegie medallist, followed with a paper, entitled "Practice and Theory." He cited a number of interesting examples from actual shop practice and showed wherein theory had been beneficial.

In discussing the paper, R. Buchanan said that he found it most difficult to decide whether a job on a molding machine would pay or not.

Mr. Cooke said that during the past few years there had been a flood of science in connection with foundry work, and he was glad to find Mr. Longmuir taking something from the practical side. While they knew the value of theoretical work, they were finding every day that theoretical analysis was not everything; and they could all testify to the truth of the statement that identical analysis might produce absolute different results. They had to work from day to day to make castings, giving certain practical results, and which were bought from physical properties, not on chemical analysis. Therefore, it was the duty of everyone who had to produce castings of a high class character that he should have physical tests carried on. Personally, he had tests every day bearing upon shrinkage, deflection, and tensile strain, and the money would be well spent by anyone who did that regularly.

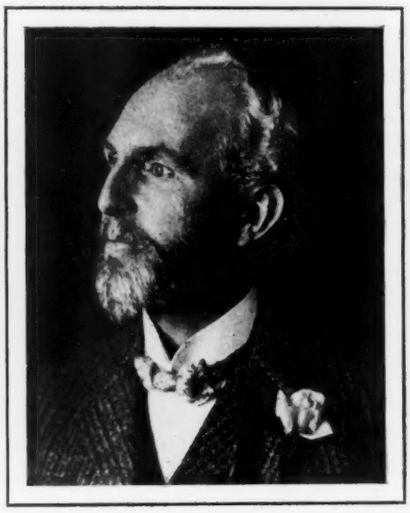
The president described the paper as exceedingly interesting, and it was clear that the answer to many of the problems suggested lay in the direction of further research. If these statistics were kept, some day the solution of those mysteries would be found. A vote of thanks was accorded Mr. Longmuir, to which he briefly replied.

Evolution of the Foundry Industry.

"The Foundryman, Past, Present and Future," was the subject of a paper read by W. N. Sherburn. He directed attention to the changes which have taken place in the foundry industry in recent years that have resulted in a wide separation between the em-

R. W. KENYON
Member Council, British Foundrymen's Assn.

ROBERT BUCHANAN
Member Council, British Foundrymen's Assn.



H. SHERBURN
Member Council, British Foundrymen's Assn.

ployer and employe to the disadvantage of both; the almost total abolition of the apprenticeship system in English foundries, and he ventured the opinion that the introduction of the molding machine has had the effect of lowering the status of the molder in whose line it has been introduced.

Discussing this paper, Mr. Poole regretted that the time has gone by when the molder regarded himself as an artist, and yet there was no occupation which called forth to a greater extent the finer senses. He believed they should cultivate the idea that molding is an art that a man should be proud to be engaged in. No doubt the indifference among many molders was due to the introduction of the molding machine. The feeling with which that machine was regarded was due to the fact that it had increased the worker's toil, instead of reducing his labor. There is too much indifference among foremen with regard to the condition of the youths placed in their care, and the desire to see them accomplished molders was too often absent.

Mr. Smith said he had been very much delighted with the paper, which dealt with familiar subjects; at the same time the foundry manager had so much to carry in his head that if he carried out Mr. Sherburn's suggestions he could not manage the foundry. He had often heard it suggested that they should do away with wasters, but that statement was always made by non-practical men, and none of their critics were able to give them any suggestions how to make castings better.

Work of the Ancients.

Prof. Turner remarked that the historical part of the paper was very interesting. They knew that the old Ninevites, the Israelites, and many of the early nations produced original work some of which was still preserved, and when they looked at some of the productions of the Middle Ages, they could not help being filled with wonder and admiration for the skill of the craftsmen who could do those things, some of which were still exhibited at South Kensington and other places. In this country the ironmaker was generally honored, but there were some few countries where ironmakers were not highly considered. In India, for example, the ironmaker is low caste.

The Molder in India.

Mr. Howe (India) said he could confirm what Prof. Turner had said about the position of the ironworker in India. They were supposed to belong to a menial class, far below the man supposed to be educated. In comparison with America, they were all very much behind. The Americans are the pioneers of the foundry world, and the British Foundrymen must do their best to organize a system of education, for their own special line, suitable for the requirements and difficulties of the trade, and secure for them a scientific and technical education.

Tuesday Afternoon.

Tuesday afternoon was spent in a visit to the works of the Sheepridge Coal and Iron Co., Ltd., the invitation having been extended by Herbert Pilkington, who is president of the association and manager of this concern. The special attraction, of course, was the excellent group of pipe foundries, and general foundries, which constitutes a most important part of the concern. The company is one of the best examples of the great self contained iron making establishments, inasmuch as it comprises three collieries with an output of a million tons of coal a year, while in addition the firm has large interests in two other great collieries namely the Newstead and Dinnington main collieries, which between them produce nearly a million and a half a year.

The firm has three blast furnaces, all of them now in blast, with calcining kilns and stoves equipped with modern blowing engines. It has a hundred coke ovens, and an annual output of pig iron of about 70,000 tons. In addition there are two Siemens furnaces, and three mills with 20-inch, 12-inch and 10-inch trains, the total capacity being 24,000 tons per annum. The forge has twenty puddling furnaces and the steam produced by the waste gases is utilized for driving the mills.

Pipe Foundries.

The pipe foundries have a total output of 24,000 tons per annum, and in the production of cast iron pipe the firm has a world wide reputation. There are three foundries with every equipment for making pipe from one- and one-half inch to 12 inches.

Two other foundries are devoted to general work and are capable of dealing with castings up to 50 tons in weight, turning out about 6,000 tons per annum. There are spacious engineering shops, comprising pattern shops, and machine and directing shop, fitted with the latest machinery for planing, drilling and slotting. In this department all the machinery is electrically driven. Special shops are devoted to repairs of the company's 3,000 railway wagons.

Power Plant.

A most important department is the power station with a couple of dynamos driven by blast furnace gas engines. The gas for driving these is taken from the blast furnace main in pipes through a washer box, scrubbers and condensers into a holder, and thence to the gas engines. There are very powerful hydraulic engines, and excellent locomotives for conveying trucks to the Midland Railway and Great Central Railway, whose lines are close to the works.

An important feature of the power stations is the employment of a three cylinder vertical Westinghouse gas engine driven by blast furnace gas, direct coupled to a continuous current dynamo capable of giving an output of 600 amperes at a voltage of 230.

Wednesday's Proceedings.

The proceedings of the convention were continued on Wednesday, Herbert Pilkington presiding. The absence of civic and other functions rendered the proceedings less formal, and the earlier part of the morning was spent in a general inspection of the applied science department of the university. The immediate object of the tour was to listen to remarks from T. Swinden, one of the most brilliant of the younger generation of scientists in the north of England, and who is a Mappin medallist and an 1851 Royal Exhibition scholar.

Mr. Swinden, who last year gave a lucid and comprehensive account of pyrometers, spent an hour in a series of practical demonstrations with the several instruments employed at the university. The demonstration was a kind of supplement to last year's paper of high temperature measurement.

Mr. Swinden explained the use of the various instruments, pointing out the important part played by the galvanometer, and illustrated the use of the camera arrangement set up several years ago by Prof. Arnold.

Special attention was devoted to the Le Chatelier apparatus installed in the early nineties by Prof. Arnold, which, notwithstanding the enormous developments made, still holds the field as producing the finest recalescence curves yet published. Mr. Swinden pointed out that the apparatus embodied all the fundamental principles of thermo-electric pyrometry.

Dealing next with the conversion of scale readings in millivolts or millimetres into degrees, Mr. Swinden showed that by the ease of standardizing and calibrating, the thermo-electric instrument scored heavily over the resistance and optical instruments.

The speaker proceeded to show a satisfactory method for the every-day worker in the utilization of scale reading by comparison with the heat of boiling sulphur, boiling Selenium, solidifying lead and solidifying silver. The scale equivalent in degrees could be marked off, and if necessary a calibration curve would be plotted. Such tests are very useful to discover any deterioration of the instrument.

Thermo-Electric Pyrometers.

For annealing, heat treatment and general work a thermo-electric pyrometer can scarcely be equalled, yet there are some cases where their application is almost entirely prohibited, and others where they are not suitable, for example, in dealing with molten metal casting temperature, and inaccessible positions in a furnace. For such work a radiation or optical pyrometer is almost indispensable.

The speaker gave examples of the use of the Wanner and Mesure and Nouel optical instruments, but considered the pyrometer by Fery more useful. This instrument he considered was unique in that a continuous record could be taken just as with an ordinary thermo-couple. Very good work could be done with the Siemens water pyrometer where intermittent readings only are required.

After the demonstration the reading of papers was resumed in the main hall.

The president announced that he had received a telegram from Prof. Arnold, who regretted that business in London prevented his attendance. A hearty vote of thanks was accorded Mr. Swinden for his demonstration. E. Houghton next read his paper on special alloys for foundry use, which appears elsewhere in this issue.

Discussion of Ferro-Alloys.

The president said that the paper contained information of great value to the ordinary foundryman, of a kind not generally accessible. His own opinion was that much more alloy work would be done in the future.

R. Mason said he had used ferro-manganese for some time. After using a small portion he recently tried to raise it, but had trouble in the shape of small blowholes in the castings, through which water would leak. He found also a deposit of some brown material which looked like oxide of iron of the color of chocolate, and after exposure to the air turned brown like ordinary rust. It appeared to affect the thin part of the casting where it was 3-16 to half an inch thick.

Prof. Turner remarked that the blast furnace method had been used to prepare these alloys, while another method used to an increasing extent was the pearlite process for the production of vanadium alloys and titanium. In regard to alloys the steelmaker and ironfounder were in a different position, because the steelmaker was obliged to make additions and acquired the habit of doing that, whereas the ironfounder did not use them. It was the exception, rather than the rule. Consequently there was more danger to the ironfounder in the use of alloys. Besides that, the ironfounder could get the necessary composition by suitable mixture of iron, and no doubt that was the proper way and most preferable.

Beneficial Effects.

With regard to alloys he had studied many of them and he did not know a single element which had not a beneficial effect in suitable proportion and under certain conditions, and not even sulphur could be regarded as an enemy. For chilled or strong rolls, they could not produce them without sulphur or some hardening element. With regard to manganese, it was used by the great majority of car wheel founders in America, and was put in the ladle before casting. Apparently it helped to secure the right amount of chill, and the right backing to the chill. About 20 years ago he made a number of tests particularly for the Woolwich arsenal which led him to the conclusion that manganese could not be shown to produce any effect up to ½ per cent. Beyond that it was a doubtful quantity.

Silicon.

Silicon also had been applied by Mr. Outerbridge for other purposes in the form of high silicon added to the ladle before casting. That was a new idea introduced in 1867 and widely applied. It was given up because ferro-silicon was so much more expensive than ordinary silicon. With regard to the brown spots mentioned by Mr. Mason, it might be manganese sulphate. But that could only be determined by microscopic examination or chemical analysis. The reason that silicon acted bene-

ficially was, that at the last moment it threw a small quantity of carbon in a finely divided state as secondary graphite, and apparently the mechanical properties of iron were dependent upon the separation of a small amount of temper graphite during the process of elimination. Other alloys had been used for turning white iron into gray, and making iron soft. With regard to aluminum, the difficulty met with was that if a large amount was present it caused a fine skin to come over the metal, and prevented the metal coming right to the end. Many people who started using it had dropped it owing to its irregular results.

Nickel.

Nothing had been said about the use of nickel in the foundry. It was used for some purposes to the extent of about 1½ per cent where a close grain and a soft condition was required. He had produced excellent results with it, but it was a somewhat expensive material. A good deal had been heard about the use of titanium of the special alloy. He had never known iron submitted to him defective through titanium, and that alloy was very important, because although they did not use metallic ores in this country in large quantities, the amount throughout the world is enormous. There were whole mountain ranges of ores not used on account of titanium. One difficulty arose in the smelting, but he understood that this could be overcome by using a suitable composition of slag. Personally, he had great hopes in regard to the future of these ores, because he believed that when they knew better how to smelt them, and to introduce a suitable mixture, they would get one of the best foundry irons that could be used, and one which would really be a strong gray iron.

Influence of Nitrogen.

Another debatable point was as to the influence of nitrogen, which at present was very doubtful. The Swedish authorities, who were generally careful, considered nitrogen deleterious. Calcium was another important element which was now to be obtained commercially. It is a very light metal, very strongly desulphurizing in its effect.

Oxidizing Effects of Silicon.

Mr. Mather said he was very much interested in the remark about the oxidizing effects of silicon on the cupola method. If silicon removed the oxide, the effect would be beneficial, but he had not come across any record of the occurrence of oxide of iron in cupola metal to any considerable extent. He said he would be glad to learn whether it had been identified chemically or microscopically. Pure metallic chromium could now be obtained on commercial terms, and with manganese had produced a very useful method.

R. Buchanan said that the presence of oxygen being in the metal had yet to be proven. He knew a number of experienced and scientific blast furnace men who declined to admit that in ordinary gray iron having 2½ to 3 per cent of silicon they could have oxides existing with the silicon in the metallic condition. They must first prove that it was present for removal. With regard to the mixing of metals in the cupola, Prof. Turner had taken the common sense view. It was clear that a man could only use materials with which he was familiar, to doctor his iron. But to put special alloys into the hands of a man who did not know the exact constitution of the irons he was melting, meant than in 99 cases out of 100 he would go wrong. He was playing with edged tools and would cut himself.

He had received a recipe for making ferro-aluminum from a man who made it very successfully. Suppose they wanted to mix 10 per cent of aluminum, they would take a ladle of No. 1 iron and weigh out 90 pounds of iron, adding a small amount of aluminum, stirring it. The object of putting in a small amount at a time was because of the tremendous reaction between aluminum and iron which might burn the oxide and so destroy the iron by overheating. Therefore, they waited until the temperature had lowered somewhat, before they put in the whole of their 10 pounds.

Oxygen.

The president remarked that he would be inclined to agree as to the absence of oxygen in pig iron, but that did not indicate that it was not present in castings. He might remind foundrymen that if they used scrap they would find oxygen in the casting. Personally, he had very little faith in the mixing in cupolas of extremes of pig iron.

Mr. Houghton said he thought that Mr. Mason's brown appearances in the iron might be due to the formation of manganese oxide or manganese sulphite. He had himself done a little experimenting with nitrogen, but the results had not yet been decisive. He believed it had a considerable effect, and if titanium would remove it, it would be very convenient to have an antidote so handy. The dark slag oxidizing condition he attributed to the presence of oxide in the iron. He had also tried the making of aluminum alloy. It was not a success, but he could well understand that Mr. Buchanan's method might work successfully.

Replying to a question from Mr. Sherburn, Mr. Houghton said it was generally admitted that an air furnace was considerably hotter than the metal from the cupola.

E. L. Rhead, lecturer on metallurgy, Manchester School of Technology, followed with a paper entitled, "The Changes in Cast Iron During and After Solidification."

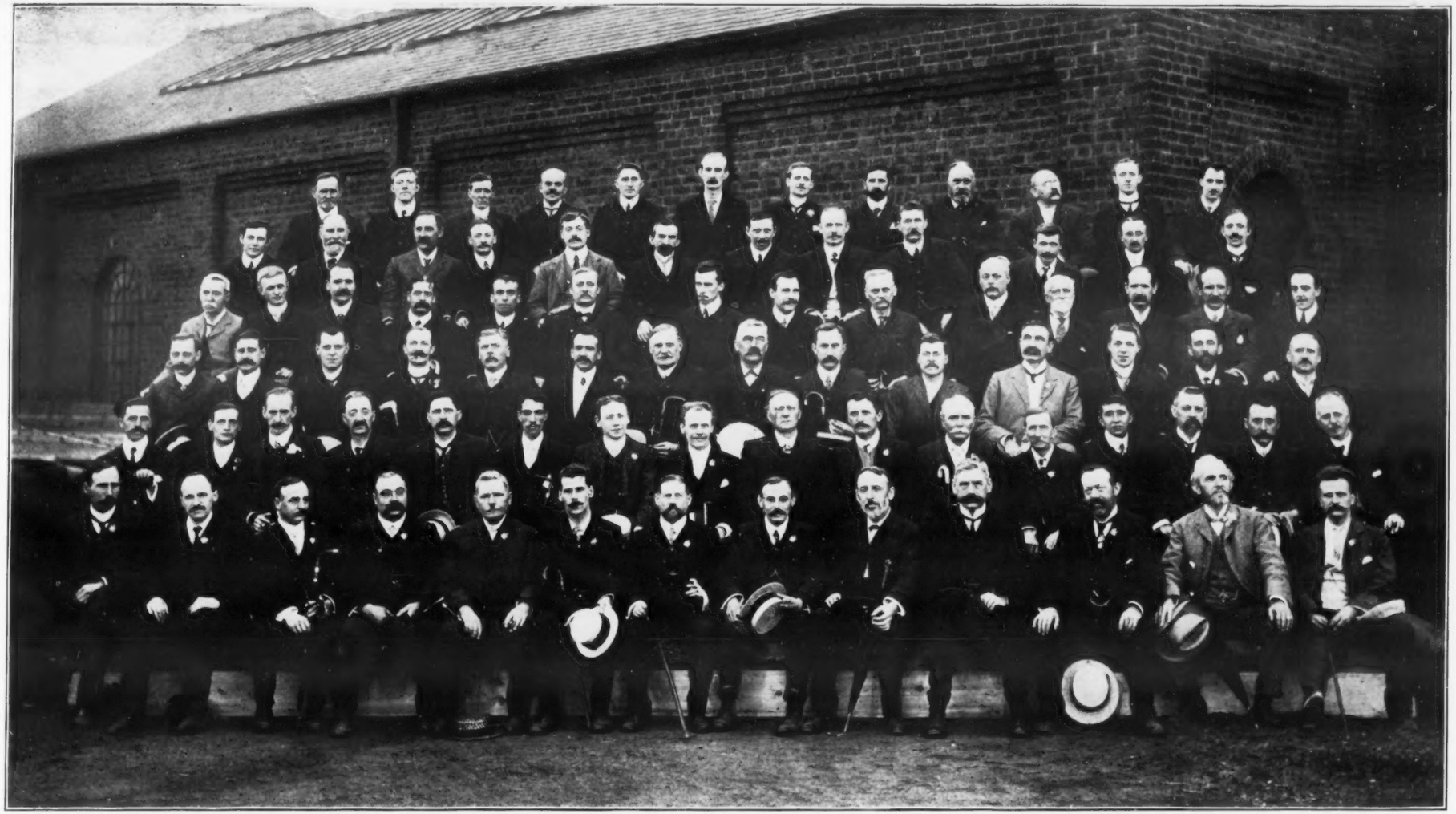
The proceedings terminated with a vote of thanks to the governors of the university for the use of the building, the local committee for making arrangements, and all who had contributed to the success of the convention.

The afternoon was spent in visits to the steel foundry of Messrs. Osborne & Co., Ltd., and to the works of Messrs. Cammell, Laird & Co., Ltd. In the evening a smoker was held, arranged by W. F. Bagnall of Sheffield. Thursday was devoted to a drive to Chatsworth, Haddon Hall, and Bakewell.

EDUCATION OF BRASS FOUNDRY APPRENTICES.

At a recent meeting of the Birmingham Educational committee, Birmingham, England, a new plan for the better instruction of brass workers was outlined. This comprises a two years' course of three evenings per week, with an optional third year's course. During the first year the student will be required to draw and sketch to scale articles presented for casting in brass foundries, and occasional lectures will be given on practical methods by workshop teachers. Instructions will also be given in metallurgy, metal coloring, and electroplating.

"The Art of Cutting Metals," by Frederick W. Taylor, M. E., Sc. D., which was the presidential address presented at the last annual meeting of the American Society of Mechanical Engineers, has been reprinted and bound in cloth by the society and may be obtained by addressing the secretary, 29 West Thirty-ninth street, New York, at a price of $3.



MEMBERS AND GUESTS OF THE BRITISH FOUNDRYMEN'S ASSOCIATION AT SHEFFIELD, ENGLAND, AUG. 6-8, 1907.

LEFT TO RIGHT BEGINNING AT BOTTOM ROW.

First Row—T. Macfarlene, R. Mason, J. Ellis, C. Jones, R. Buchanan, P. Longmuir, H. Pilkington, F. J. Cook, Prof. Turner, W. B. M. Jackson, G. Hall, W. H. Sherburn, W. F. Bagnall.

Second Row—F. Howe, R. T. Walker, C. Heggie, T. Hoskinson, W. E. Noon, G. F. Parramore, C. Fontaine, H. Bagnall, E. C. Blackmore, J. E. H. Allbut, W. Jones, F. W. Finch, M. H. Curzon, R. Altenback, W. Sword, R. F. Walker.

Third Row—T. E. Haslam, J. Shaw, J. B. Tattersall, J. Chadwick, W. Murgatroyd, J. H. Methhurst, G. M. Mather, J. Bullock, H. F. Chope, D. Dalrymple, G. Addy, A. Smith, W. N. Mainwaring, W. Sykes.

Fourth Row—A. Hopkinson, G. M. Mather, F. Andrew, B. Cannell, W. Abbott, J. Poole, S. McConnell, W. Broughton, G. W. Sloper, H. Grandidge, E. Houghton, F. Andrew.

Fifth Row—Mayor of Chesterfield, P. F. Creed, W. Peach, T. Ward, H. Winterton, J. Smith, W. A. Young, M. Pemberton, W. Hyslep, H. Jewson, G. R. Fletcher, C. Haggie, F. Andrew, D. J. Nevin.

Sixth Row—G. Phillips, I. Jones, A. E. Noon, P. Williams, H. P. Mason, T. Hoskinson, W. Hysop, W. Bagnall, R. Mather, J. Mather, T. Swindon.

FERRO-ALLOYS FOR FOUNDRY USE*

Methods of Production—Treatment of Iron to Secure Definite Chemical and Physical Properties

BY E. HOUGHTON

THE maufacture of the ferro-alloys on a commercial scale is only of comparatively recent date. They were brought into prominence first by the introduction of the Bessemer process for steel making, and the alloy which first became important was the alloy of iron and manganese. As is well known, the steel first produced by Sir Henry Bessemer was useless on acount of being red short.

It was soon found that the panacea for this ill was manganese, and it was supplied by the addition of an alloy of iron, manganese and carbon, termed spiegeleisen, obtained from Germany, and containing about 10 per cent of manganese and 4 per cent carbon. This was the richest alloy at the time available and its use in sufficient quantity to overcome the defect just mentioned introduced so much carbon at the same time that the resulting steel was of a high carbon content.

High Manganese Alloy.

As there has since then been more use for low carbon than for high carbon steel, there has been created an incentive to manufacture a richer alloy, containing less carbon relatively to the amount of manganese.

Richer ores were discovered and alloys of 20 per cent manganese were manufactured in this country, and this enabled steel suitable for rails and other purposes, with 0.25 per cent to 0.50 per cent carbon, to be made.

Still later, especially with the progress of the open-hearth process, and the large field opened for the use of mild steel of 0.10 per cent to 0.20 per cent carbon, very much richer alloys had to be used.

These were at first made in crucibles and were very costly, but very soon afterwards they were successfully made in the blast furnace much more cheaply, and are now so manufactured on a large scale and employed universally.

Other Alloys.

From the successful nature of the manufacture of this alloy and its use in steel making, other alloys were gradually introduced, and as their properties have become better known their use has extended, till at the present time their name is legion, and their application in steel and iron founding most important.

Until quite recently the only method of producing the ferro-alloys was by means of the blast furnace or the crucible. Now, however, since the introduction of the electric smelting furnace, and its success commercially in the production of rich ferro-alloys, a great variety of them are obtainable at a comparatively moderate price, and some which today are commonly used were curiosities but a short time ago.

The blast furnace alloys are few in number, though very important, and comprise ferro-manganese, spiegel, silicon-spiegel, ferro-silicon, ferro-chrome and ferro-phosphorus.

The other alloys we shall mention as important to foundrymen are ferro-aluminum, ferro-titanium, and mixed alloys of the above elements.

Carbon.

The blast furnace products will generally, I think, be the cheaper per ton, or even per unit of the valuable elements than the electrical product, but their chief drawback, especially in the steel works, has been the high percentage of carbon.

In the electrical furnace product this element can be kept remarkably low, while generally speaking the highest and purest grades can be readily obtained. It is proposed to consider each alloy separately and tables of analyses of both kinds of product are appended, showing their composition.

Until recently, the importance of the ferro-alloys has been confined more or less completely to the steel works, including steel foundries, but now quite a number of people seem to be experimenting with them in ordinary iron founding, and as they become better known to foundrymen, it is not unreasonable to expect that they may play an important part in the foundry practice of the future.

The manufacture of manganese steel and other special steels of this class has arisen from similar expeiments carried out in an intelligent manner in the steel foundry branch, and one need scarcely point out at a meeting held so near to the giant undertaking of Hadfield's, what an important result that use of a ferro-alloy has brought about.

Alloys for Foundry Use.

Their use in steel works practice is probably well known to all, and in any case it is not proposed to wander into that branch of the subject unnecessarily. Their use in foundry practice is surrounded by a somewhat different set of circumstances.

The object of their use in the foundry is two-fold:

(1) To act as deoxidizers and desulphurizers the added element remaining only in small quantities in the finished casting.

(2) To alter the composition of the casting and so to gain control of the condition of the carbon and the mechanical properties of the casting.

Ferro-Manganese and Spiegel.

The most important and abundant of the alloys of iron are ferro-manganese and spiegel, the former containing from 40 to 85 per cent manganese and the latter 8 per cent to 40 per cent of that element. The lower grades are very strong, and break with large crystal faces of mirror-like polish; hence the name spiegel-eisen (German for mirror-iron).

The higher grades lose this characteristic and become soft and friable, having a granular fracture often beautifully stained with rainbow colors due to superficial oxidation.

Analyses of the blast furnace product as made at one of the oldest works in this line in this country will be found in Table I., A and B, and analyses of metallic manganese made electrically in Table III C.

*Presented at the Sheffield convention of the British Foundrymen's Association.

is glazed foundry, not glazed forge iron. The latter is high in sulphur and of little value for softening purposes.

This method, however, results in a more or less fixed product, and if the class of work requires considerable variation in the silicon contents on the same day it is at best, an undesirable process.

By the addition of ferro-silicon, the silicon contents of each ladle can be altered at will to suit the particular castings for which it is designed.

Ferro-Chrome.

Coming now to ferro-chrome, we have an alloy which if it is to be used at all in the foundry will have to be used very sparingly and for particular work only, mainly on account of its cost. The alloy up to 40 or 50 per cent is made in the blast furnace by using very rich ores, a very large amount of coke and hot blast of high pressure, but it is very difficult to make an account of the high melting point of the metal and slag. Analyses showing up to 60 per cent are given in Turner's Metallurgy of Iron. Analyses of the blast furnace product are given in Table I E, from which it will be seen that chromium, like manganese, increases the solubility of carbon in iron. The carbon rises from 5.3 per cent of chromium to 7.12 per cent at 40 per cent chromium, and it is all combined.

The alloy can now be obtained from the electrical furnace with up to 70 per cent chromium and with very low carbon contents, especially after refining. Analyses are given in Table III A.

Since chromium converts carbon to the combined form, it is a hardener, while generally speaking in the foundry we are more concerned about softeners. Prof. Turner, who deals very fully with this alloy in his work on iron, states that ferro-chrome is unsuitable for ordinary foundry purposes.

The writer has, however, lately heard of the use of chromium in the production of castings where hard wearing properties are extremely desirable and cost somewhat secondary as for example in cast iron piston rings.

Ferro-Phosphorus.

Lastly, we have received from the blast furnace an alloy of iron and phosphorus containing up to 20 per cent phosphorus, analyses of which are given in Table I F. The metal is also made electrically in any percentage desired up to 30 per cent as per analyses in Table III E.

Ferro-phosphorus is chiefly used to enrich the phosphorus in the slag from basic steel furnaces so as to make it a saleable commodity.

The only possible use of such an alloy in the iron foundry would be in the production of very fine and thin castings, artistic work where excellency of detail was of paramount importance, and strength secondary.

From two to five per cent phosphorus according to Prof. Turner makes the metal very fluid when molten and causes it to take an excellent impression of the mold.

Such castings are very brittle, but they have to be made sometimes, and although phosphorus is an element one generally does not expect to have to pay for, still it may be there is a use for such an alloy in the foundry where the work is only offered occasionally.

This exhausts the list of blast furnace products, but by no means the list of available alloys, although on account of the scale upon which it is possible to produce, those alloys made in the blast furnace will as a rule be less costly.

Other Foundry Alloys.

Of the remainder those which have been used in the foundry are ferro-titanium, ferro-aluminum and mixed alloys such as ferro-aluminum-silicide, ferro-calcium-silicide and ferro-manganese-aluminum-silicide.

An analysis of ferro-titanium is given in Table III F. It is used in steel manufacture, where it is said to greatly increase the ductility of the steel. It also acts as a deoxidizer, at any rate at the high temperature of molten steel and in addition titanium combines with nitrogen.

To obtain perfectly sound castings it is important to remove all gases. Consequently an element which combines both with oxygen and nitrogen should be very beneficial in this respect. It seems probable that combined nitrogen plays a very important part in reducing the strength of cast iron, and if so it will be convenient to have an antidote so handy. Titanium is said to increase both the transverse strength and the hardness of the chill of cast iron.

Ferro-Aluminum.

Ferro-aluminum, of which approximate analyses are given in Table III G, is used almost solely as a deoxidizer, and it is very efficient in this role, but it is undesirable that much of it should remain in the metal.

The chief drawback to the use of aluminum for this purpose is that solid alumina is produced which is liable to remain suspended in the metal, and this causes lack of continuity of the metallic structure and loss of strength sometimes.

There has consequently been a tendency to introduce mixed alloys, and of these little need be said except they combine the properties of the other alloys, and in most cases the elements reinforce each other. They are essentially deoxidizers and solvents for gases.

Miscellaneous Alloys.

The analysis of ferro-aluminum-silicide is, I believe, the first one to be published. The alloy is very friable and readily crumbles.

Ferro-calcium-silicide, of which an analysis is given, is an interesting if unfamiliar product. Its action as a deoxidizer will be very powerful.

Ferro-manganese-aluminum-silicide is also another of these mixed alloys, which have been sucessfully introduced in some foundries and it should be a very useful alloy for foundry purposes.

NEW SOLDERING COMPOUND.

A new solder has made its appearance in Germany. It is composed of lead and tin in the form of an impalpable powder, which is mixed with chloride of zinc and made fluid with glycerine or vaseline. This paste is spread over the surface or joint to be soldered and heat applied. The metal melts and appears within the paste in globules. No oxidation takes place and the joint is very clean. The solder has been named "Tinol."

SUBSTITUTE FOR PLATINUM.

Charles H. Birmingham, of Baltimore, Md., has patented the following alloy as a substitute for platinum: Silver, 16½ ounces; nickel, 4 1-5 pounds; bismuth, ½ ounce, and gold, 53 pennyweights. The inventor claims that this alloy can be used as the leading in wires for incandescent lamps, contact points for electric vibrators and in all classes of electrical appliances where high resistance is required.

OLD FOUNDRY DISMANTLED.

The foundry conducted by the Gordon & Malven Co., Port Jervis, N. Y., will be dismantled and equipped for an automobile garage. The foundry was one of the oldest in the country, having been established in 1851 by Utley Hare, a pioneer foundryman, who is still living in New York. A year after its erection Mr. Hare and Benjamin Bull organized the Neversink Foundry & Machine Works, which was located in a brick structure, 32 x 100 ft., and was devoted to the manufacture of stoves and plow castings as well as jobbing work. The firm name was later changed to Van Fleet, Bull & Co., and some time afterward James Van Fleet, the senior member of the firm, came into sole possession. It was then purchased by Charles St. John and later George Malven became a partner and the firm name was changed to St. John, Malven & Co.

FOUNDRY AND PATTERN SHOP APPLIANCES AND SUPPLIES

Continuous Cupola Tuyere System—Molders' Bulb Sponge—Cyclone Bellows—Chain Block for Brass Foundries

A CUPOLA tuyere system designed for the introduction of a large volume of air into a furnace at a low pressure, thereby insuring a low melting point, and uniform operating conditions, has been designed by J. C. Knoeppel, 577 East Ferry street, Buffalo, N. Y., for which patents are pending in both the United States and Canada. The inventor has had more than 20 years experience as a foundry manager and has devoted considerable time to the study of melting problems.

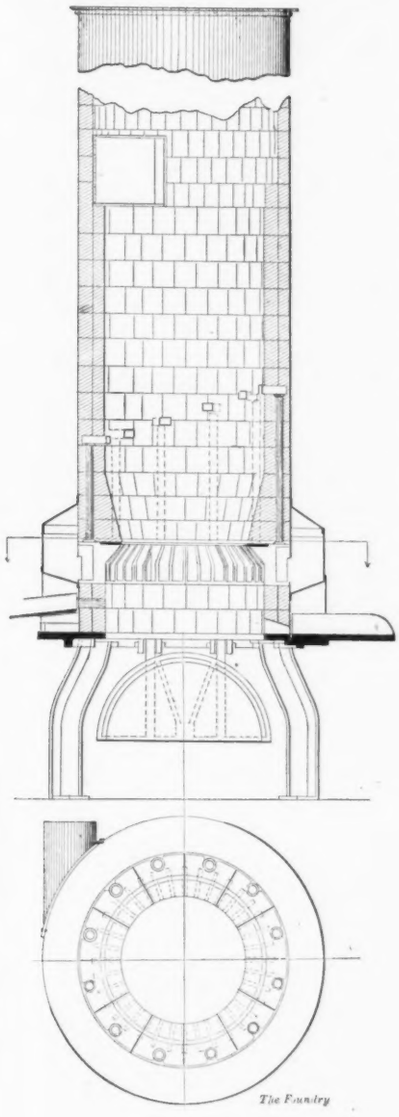


FIG. 1—SECTION OF CUPOLA EQUIPPED WITH KNOEPPEL TUYERES

The fundamental principle underlying good cupola work is the introduction of the required amount of oxygen into the cupola in such a manner as to procure an even temperature throughout its circumference, thereby avoiding cold spots. To accomplish this, the blast should be uniformly distributed and the tuyere area should be as large as possible. If the cupola lining is allowed to take its own course, it will be found that it will build out slightly above the tuyeres and form a bosh over them. Recognizing the advantages to be derived from large openings in the delivery of air at the lowest possible pressure, so as to avoid irregularity in melting, the tuyeres have been arranged as shown in Figs. 1 and 2. The castings composing the tuyeres are in segments and form a continuous belt around the cupola. In large furnaces, the upper and lower portions of the tuyeres are made in two sections, while for cupolas of smaller capacity they are cast in one section.

A vertical section through a cupola equipped with the Knoeppel tuyere system is shown in Fig. 1, and at A in Fig. 3 is shown one of the tuyeres provided with a safety notch in the center so that when the iron rises to this point it will flow through this depression and escape through a soft metal plate, thus warning the melter before the iron flows into the tuyeres proper. At B, Fig. 3, is shown one of the key tuyeres. Its upper flange overhangs the adjacent tuyeres, while the lower portion is made with parallel sides so that it can be drawn into the center of the cupola, thus releasing the other tuyere blocks. The tuyere blocks above the spout and over the slag hole usually have their lower tier of openings stopped with brick to avoid any liability of chilling the outflowing slag or metal.

One of the most important features in connection with this system is that it may be said to have practically two independent wind belts which give the air an opportunity to equalize in pressure both inside and outside of the shell, thus insuring equal pressure at each of the tuyere openings. The outside wind belt is a metal casing, as in the better style of cupola mountings, while the inside belt is formed by cutting back the vertical partitions of the tuyere blocks at the side next the cupola shell, as shown in Figs. 4 and 5. A series of openings through the shell

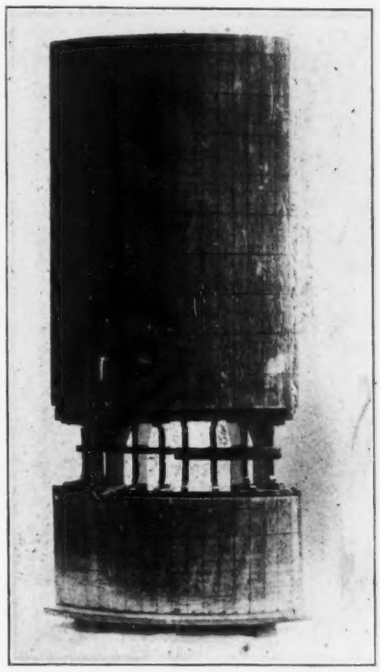


FIG. 2—VIEW OF VERTICAL PIPE IN CUPOLA LINING

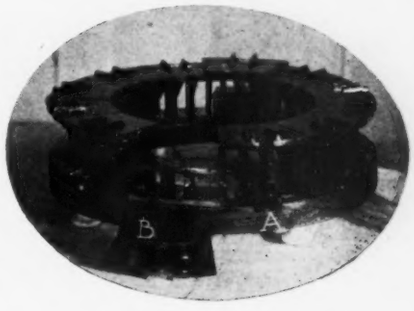
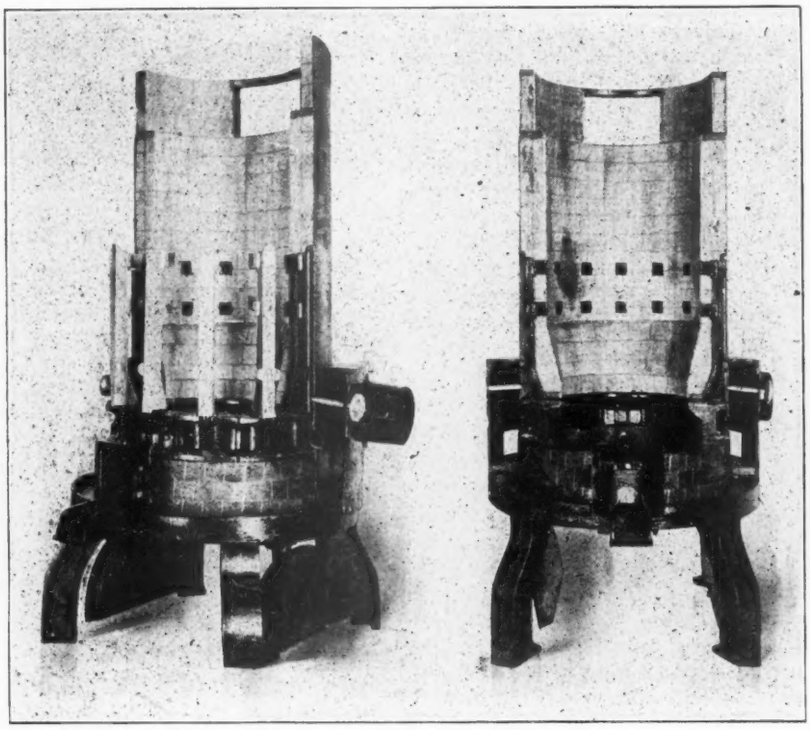


FIG. 3—TYPES OF TUYERES

admits air to the back of the tuyere blocks and it then flows through the inside air space. By making the tuyere area ample, the air flows at a relatively slow velocity and has an opportunity to lag or rest in the tuyeres for a short time, thus enabling it to take up some of the heat and to enter the cupola or furnace in the best possible condition for rapid combustion. The overhanging upper edge of the tuyere blocks effectually prevents the slag or metal in its downward course from flowing into the tuyeres and blocking them. It also prevents the coke from falling into the tuyeres and closing them, thus insuring an ample opening at all times during the heat. In the ordinary cupola construction the lining is carried up vertically for a short distance above the tuyere blocks and is then flared outward, forming the bosh. The brick lining is supported by angle irons riveted to the shell as usual, so that the tuyeres can be removed if necessary should any change in their arrangement be required.

Another feature provides for the introduction of air above the melting point, with a view to the utilization of the heat contained in the gases to its fullest extent. These openings are arranged by providing notches in the top of the tuyere blocks which connect with vertical pipes next to the one on the inside of the cupola. These are provided with nozzles leading through the lining shown in Figs. 4 and 5. The nozzles are secured to the pipes with dovetail joints, so that they can be easily replaced. While melting, a small amount of air is admitted to the cupola through these vertical pipes and combines with the carbonic oxide gas. The heat thus set free is to a considerable extent absorbed by the material as it settles toward the melting point in the cupola, thus preparing the metal for more rapid melting. These vertical pipes can be closed with dampers or valves which can be adjusted to regulate the amount of air to be admitted. The method of setting these vertical pipes in the cupola lining is shown in Fig. 2. At the close of the heat, the dampers in the vertical pipes can be opened wide and the volume of air thus admitted aids materially in effecting a rapid cooling of the lining. In small cupolas the amount of the tuyere overhang on the inside is necessarily reduced, and possibly in some cases it would be entirely eliminated, and flush or vertical tuyeres be used. Cast iron plates have been provided for these vertical tuyeres which can be set over the tuyeres to form an overhang of from one to two inches, thus providing a small amount of boshing.



FIGS. 4 AND 5—SECTIONS OF CUPOLA SHOWING VERTICAL PIPES AND CONTINUOUS TUYERE SYSTEM

The principal advantages claimed for this system are as follows:

First—The introduction of a large amount of air at a low pressure, insuring a low melting point and uniform operating conditions.

Second—By the use of the overhanging upper portion of the tuyeres the liability of their stoppage is greatly reduced, permitting longer heats to be taken from the cupola.

Third—The inside wind belt insures a thorough equalization of the blast pressure and provides equal melting at all points around the circumference of the cupola, which cannot be fully attained when the tuyeres are not continuous, and the air supplied through only one wind belt.

Fourth—The shape of the tuyeres, together with the use of the safety tuyere reduces the liability of stoppage caused by the metal rising in the tuyeres to a minimum.

Fifth—The vertical pipes with the supplementary openings into the cupola enable the operator to control the conditions above the melting point.

Sixth—The delivery of air much nearer the center of the cupola than where the tuyeres are flush with the ling. The tuyeres project from 2 to 7 inches into the cupola, reducing the diameter at the tuyeres from 4 to 14 inches, at the same time maintaining a large hearth below.

Seventh—The cupola can be relined to a smaller diameter without removing or disturbing the main tuyeres, a flexible or overhanging plate being provided which can be used in conjunction with the main tuyeres.

These tuyeres can be placed in any cupola now in use, and can be operated independently of the air supply pipes if desired.

MOLDERS' BULB SPONGE.

The accompanying illustrations show a molders' bulb sponge manufactured by the Hill & Griffith Co., Cincinnati, which is designed to replace the ordinary sponge and quill used in foundries for sponging molds. It is made of a rub-

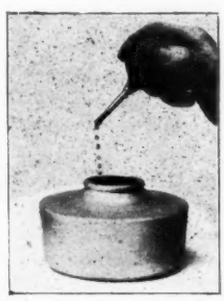


FIG. 1—MOLDERS' BULB SPONGE

ber bulb with a hollow stem attached and in the outer edge of the stem is loosely fitted a wisp of fine hair. A reservoir or can is provided with each sponge, having an opening in the top of a size suitable to support the sponge while filling from the reservoir, as shown

FIG. 2—RESERVOIR FOR MOLDERS' BULB SPONGE

in Fig. 2. By the use of this sponge it is unnecessary for the molder to put his hands into water and it is designed to supply a tool in which a good supply of water is always ready for use and which is constantly under the control of the molder. The sponge is filled by expelling the air from the bulb by squeezing, and then inserting it in the water. It is claimed that by its use the molder can sponge a mold without wetting his hands and considerable time is saved, as the molder can place the reservoir wherever it is needed. This device can be used at any angle below the horizontal and the water will always drop off the end of the wisp. This feature permits the molder to reach many points in the mold that are usually difficult of access to the ordinary sponge, thus materially decreasing the time required in finishing the molds.

E. H. MUMFORD CO. SECURES AMERICAN AGENCY FOR FRENCH MOLDING MACHINES.

The E. H. Mumford Co., Philadelphia, manufacturer of molding machines, has secured the exclusive sales agency for America for the new French molding machines and the accompanying systems of pattern-making recently introduced into this country by Ph. Bonvillain & E. Ronceray, Paris, France. At present the machines are being imported from France in the face of a heavy tariff, but arrangements will be shortly completed for their manufacture in this country. The exhibition rooms at 1315 Race street, Philadelphia, are equipped with operating machines of various sizes and types, and men skilled in the French pattern plate processes demonstrate the many novel advantages of this system of machine molding.

HIGH SPEED TRIPLEX BLOCKS FOR BRASS FOUNDRIES.

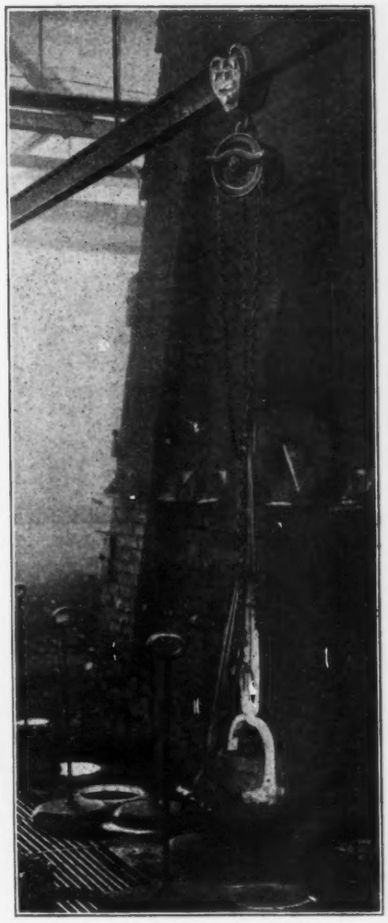
Increasing interest is manifested by brass founders in the use of chain blocks, or other appliances for handling crucibles. In many plants the work is constantly growing heavier and the pots are naturally increasing in size and weight.

The general impression is that the regular one-ton triplex block is too slow for this class of service, where the maximum weight seldom exceeds 250 pounds, and quick work is required to prevent the metal from cooling. Experiments in the use of chain blocks for this purpose made by the Yale & Towne Mfg. Co. in its works at Stamford, Conn., showed that the quick speed blocks such as are used for handling ammunition in the United States coast defenses are not as rapid in their action as desired for handling pots of metal. As a result a special high speed block has been developed, as shown in the accompanying illustration, which meets with the views of the brass molders in the plant of the Yale & Towne Mfg. Co.

It raises a pot of metal, weighing, with the tongs, 350 pounds, with a pull of 40 pounds on the hand chain. It is offered on the market as a quick speed triplex block by the Yale & Towne Mfg. Co., New York, and will be furnished on 30 days' trial to brass founders desiring to try it out in their works.

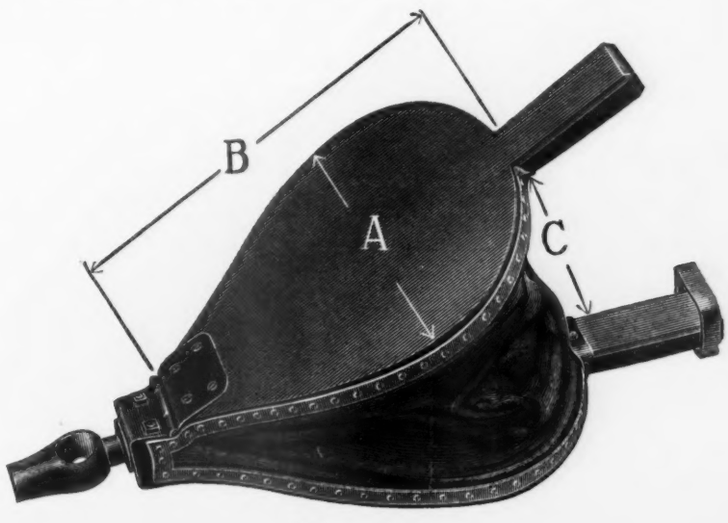
CYCLONE BELLOWS.

The Osborn Mfg. Co., Cleveland, manufacturer of foundry supplies, has recently placed on the market a patented outside hinge molder's bellows, known as the Cyclone, shown in the accompanying illustration. The superior points claimed for this bellows are its ample size and wide opening, which in connection with its new malleable spout, makes it a good wind producer. The spout has a direct wind drive with side



CHAIN BLOCK FOR BRASS FOUNDRIES

holes which prevent any back pressure, thus producing the maximum amount of wind with each pressure of the bellows.



CYCLONE BELLOWS

TRADE NOTES.

Bassite, a substitute for tin in the manufacture of brass castings, is being offered to the foundry trade by the Bassite Mining & Smelting Co., Commercial Tribune building, Cincinnati. It is claimed that this material has all the characteristics of tin and in addition gives an advantage in wear and lasting qualities of over 25 per cent above those of the metal made with tin as an alloy. When used in place of tin it makes a denser casting and it is stated that porosity is almost entirely obviated. By comparison it has been shown that a machine hand can produce 30 per cent more work a day where Bassite is used in the mixtures. A metal cast with Bassite in the mixture will not burn in the sand and leaves it free and clean.

The Hafer Sand Co., 505 Washington avenue, Newport, Ky., has been organized for the purpose of mining and shipping molding sand from an almost inexhaustible bank containing eight acres, located at Augusta, Ky. Borings have been made to a depth of 75 to 100 feet in various places on the tract and all indicate a very superior molding sand. The bank contains sand ranging from a fine yellow to a fine and coarse red especially adapted for brass, stove plate, malleable, light and medium gray iron castings. Those interested in the enterprise are James Hafer, James Hafer Jr., Louis Hafer, and Frank W. Swormstedt.

The S. Obermayer Co., Cincinnati, manufacturer of foundry supplies, is erecting an addition to its plant for the production of a new dry core compound, known by the trade name of Kantbebeat. The plant will have a capacity of 25 tons per day. One of the most important properties claimed for this compound is that it will not draw moisture and cores made with it can be used from six months to a year after they have been made. The cores will crumble readily, thus reducing the cost of cleaning to a minimum, and a few raps from a hammer is sufficient to disintegrate the core. Furthermore it is claimed that this compound emits about ¼ as much gas as the ordinary oil or flour mixture and can be used at a greatly reduced cost.

The Robeson Process Co., Camden, N. J., is mailing to the trade a handsome Russia leather letter case, as a souvenir of the convention of the American Foundrymen's Association recently held in Philadelphia.

The new plant of the Hill & Griffith Co., Cincinnati, manufacturer of foundry facings, supplies and equipment, was placed in operation July 3, and has been operating in full since that date. Finding its capacity insufficient to meet its requirements, orders have been placed for a large amount of additional machinery, which is to be delivered as rapidly as it can be secured from the makers.

The Laclede Fire Brick Mfg. Co. and the Christy Fire Clay Co., St. Louis, have organized the Laclede-Christy Clay Products Co., and will operate the Laclede plant of the former and the Christy plant of the latter. In addition to furnishing linings for cupolas, brass and heating furnaces, cement kilns, etc., this concern will make factory plans, will draw specifications and will take contracts for the construction of coke ovens, metallurgical factory buildings, furnaces, etc. The officers of the company are as follows: Wm. C. Morris, president; John L. Green, vice president; Richard D. Hatton, secretary and treasurer.

The Dayton Pneumatic Tool Co., Dayton, O., manufacturer of pneumatic hammers, air compressors and appliances, has established an agency in Buffalo with Root, Neal & Co., 178-180 Main street, to look after its constantly growing business in that territory. This concern will carry in stock a complete line of Dayton and Green pneumatic hammers, as well as repair parts and accessories.

The British Mineral Co., Manchester, England, miner and shipper of fluorspar, is producing this product with almost any desired percentage of fluoride of calcium and is in position to make shipments containing 45, 65, 75 and 95 per cent fluor and only 2 to 4 per cent of silicon. The shipment of any required analysis is a new feature in the fluorspar trade. Much of the English fluorspar, which has been used to a large extent in this country, has been low in fluor content and ranged from 10 to 15 per cent in silicon. This new material will undoubtedly be well received, for the reason that it will not be necessary to handle as large a tonnage to procure the desired results, thereby effecting a saving in the extra cost of handling and freight. This material is mined in the Manchester district and conveyed on cars to the Manchester steamship line and carried as ballast to the United States for distribution to foundries, steel works, etc. The shipments are made monthly and the railroads in this country carry this imported material at low rates and figure as gross tons instead of net tons, as has been customary. The British Mineral Co. has made arrangements with the J. W. Paxson Co., Philadelphia, to handle this fluorspar in the United States.

The Central Foundry Supply Co., Columbus, has been organized to engage in the sale of foundry equipment and supplies of all kinds. This concern is the agent for the line of equipment manufactured by the Northern Engineering Works, Detroit, and has been appointed exclusive agent for the Federal Steel Fixture Co., Chicago. It also acts as general agent for the Conneaut Patent Shovel Co., Conneaut, O., and in addition sells the products of about 60 different concerns. The officers of the company are: J. S. Ball, president; D. R. Mason, vice president; C. E. Whiton, secretary and treasurer.

R. MacKellar's Sons Co., Peekskill, N. Y., manufacturer of foundry facings, is adding another large warehouse and installing machinery that will practically double its output. During the past two years this concern has been unable to make shipments in less than six weeks to two months. These additions, however, will increase the capacity to such an extent that prompt deliveries can be made.

Cattelani Bros. & Co., Genoa, would like to be placed in communication with concerns desiring to do an export trade in the line of foundry supplies and equipment. Their main office is at Genoa, Italy, 4, Vico del Campo, with branches in the following cities: London, 1st floor, Hopetoun house, Lloyd's avenue, E. C.; Milan, 2, Via Cesare Cantu; Rome, Via Cavour, 269-71-73; Florence, 4, Via Tornabuoni. Works, Spezia, Italy.

The Falls Rivet & Machine Co., Cuyahoga Falls, O., manufacturer of the Wadsworth improved core machines, core oven equipment, core ovens, and other foundry equipment, has purchased the stock, patterns, tools, good will, etc., from the Kent Mfg. Co., Kent, O., for the interest under which this concern was manufacturing the Wadsworth improved core machine. The Falls Rivet & Machine Co. will furnish any repairs for any machines previously furnished by the Kent Mfg. Co.

The Northern Engineering Works, Detroit, recently installed a 5-ton, 3-motor electric Northern traveling crane of 72-foot span in the South Rocky Mountain plant of the Atlantic Coast Line.

The Western Foundry Supply Co., East St. Louis, Ill., has opened an office in New York at 99 John street. The company recently completed its new plant at East St. Louis and is building a new mill in New Jersey. The combined output of these two plants in the products manufactured by this company, including ferro-silicon, ferro-manganese, ferro-chrome, and other refractory materials,

is considerably greater than its former capacity and will enable it to make prompt shipment on orders from any section of the country.

The H. E. Mills Mfg. Co., Syracuse, N. Y., has been organized with $175,000 capital, to take over the dry core compound and foundry suppy specialty business of the C. E. Mills Oil Co. of that city, and of the Buckeye Milling Co. of Cleveland, O. The directory board includes H. E. Mills, Thomas Wheatley, Herbert W. Smith and Frank T. Miller, all of Syracuse, and Walter A. MacMullen of New York. Mr. Mills is president, Mr. MacMullen, vice president; M. A. Raus, treasurer, and Ralph Ditty secretary. Mr. Mills states that the company will continue the manufacture of Mills' No. 1 and No. 2 dry core compounds and Ladelene compound for lining ladles and cupolas and of special foundry flours and core wash, as made by the Buckeye Milling Co. The new company will also serve as selling agent for the core oils of the C. E. Mills Oil Co. Plants are now operating in Cleveland and Syracuse and the company expects to erect another at Milwaukee, Wis., in the near future.

The J. D. Smith Foundry Supply Co., Cleveland, has purchased the old plant of the Variety Iron Works, on Scranton avenue, adjoining its own works. The property consists of a machine shop and warehouse and contains about 60,000 square feet of floor space. This will be used for the engineering department, which has expanded so rapidly as to require more room for its operations. The equipment has been installed and the plant is now ready for operation. The offices of the J. D. Smith Foundry Supply Co. have been moved from South Water street to the building formerly used for this purpose by the Variety Iron Works.

The Pike Mfg. Co., Pike, N. H., has brought out a very novel desk device, termed "The Office Fillaneed." This consists of an aluminum plate, carrying a rule on either edge, one divided according to the metric and the other the American system. A thick blotting pad is secured to this plate, which is sufficiently heavy to serve also as a paper weight. For a handle the plate carries a small whetstone. The device is put up in an attractive box.

Edward J. Etting, Philadelphia, has been appointed sales agent for the molding machines manufactured by the Killing Machine Co., Davenport, Ia., for the following territory: Pennsylvania, east of the Allegheny mountains; New Jersey, Delaware, Maryland and Virginia.

Judge Archbald, presiding in the United States circuit court, district of New Jersey, has rendered a decision in favor of the Ajax Metal Co., Philadelphia and Birmingham, relative to infringement made upon its patent covering plastic bronze. This decision fully sustains all the claims made by the Ajax Metal Co.

The Northern Engineering Works, Detroit, builder of cranes, recently furnished the Pennsylvania Railroad Co. one 5-ton, 3-motor electric traveling crane with 55-foot span, for its Altoona, Pa., shops.

The Waldie & McCauley Sand Co., recently organized to ship Rockaway Beach sand for foundry purposes, has incorporated under the name of the Atlantic Coast Sand Co. The old offices at 523 West 124th street, New Work, will be maintained. The company is meeting with such success in introducing its beach sand that its fleet is steadily being increased.

TRADE PUBLICATIONS.

CONVEYING AND POWER TRANSMISSION MACHINERY.—Link-Belt Co., Philadelphia. Bulletin No. 73. Devoted exclusively to a description of conveying and elevating machinery designed for foundry work, and illustrates a 227 foot flask conveyor installed by the Westinghouse Air Brake Co., Wilmerding, Pa., pig iron and coke elevators and sand handling machinery.

INSULATOR SUPPORTS.—The Electric Controller & Supply Co., Cleveland. Sixteen page booklet. Describes the Universal insulator supports manufactured by this company, which can be used in any position on the flanges of any rolled structural shape, round, square and flat bars, gas and water pipes, edges of tanks, plates, etc. They are made of malleable iron.

PNEUMATIC SAND RAMMERS.—Chicago Pneumatic Tool Co., Chicago. Four page circular, devoted to a description of the sand rammers manufactured by this company for use in concrete and foundry work. The Chicago sand sifters are also shown, as well as the Franklin air compressors.

UNIVERSAL TRIMMERS.—Fox Machine Co., Grand Rapids, Mich. Catalog No. 70. Twenty-four pages. Illustrates and describes the full line of trimmers manufactured by this company, as well as the Fox dado or grooving heads, mitering machines, and post boring machines. This catalog is handsome typographically and is printed on a heavy coated paper.

INDUSTRIAL AND PORTABLE RAILWAYS.—Arthur Koppel Co., Pittsburg. Bulletin No. 205. Twelve pages. A full line of industrial and portable railway equipment and accessories are described in this bulletin, including turntables, cast steel wheels, portable switches, charging cars, ladle cars, etc.

PATTERNMAKERS' SUPPLIES. — Cleveland Fillet Co., Cleveland. Sixteen page catalog. Describes the Crescent leather fillet made by this company, with directions for its use, as well as wood fillets, wood, brass and malleable iron dowel pins, white metal and brass pattern letters and figures, malleable iron rapping plates, metal joint fasteners, polished steel fillet tools, pinch dogs and other patternmakers' supplies. The new Foley saw filing and jointing machine is also illustrated and described.

CORE BOX MACHINES.—Catalog No. 72. Eight pages. Issued by the Fox Machine Co., Grand Rapids, Mich. Illustrates and describes core box machines designed to reduce the cost of patternmaking by greatly reducing the amount of time consumed in making core boxes and to provide greater accuracy in this class of patterns than is possible by ordinary hand work. These machines also make unnecessary the selection of clear even grained stock, which is so essential for core boxes that are to be worked out by hand. Some of the intricate boxes made on this machine include a semi-circular, compound curved core box; half turned core box with straight extensions; trap core box; quarter turned core box with slant extensions; compound quarter turned core box; semi-circular and hemispherical core box. It also shows a semi-circular core box cut from a solid knot.

BUTT WELDING PIPE. — Goldschmidt Thermit Co., New York. Twelve page booklet, describing the butt welding of wrought iron and steel pipe and rods by the thermit process. By this method tubes for steam pressure, deep well lining, hydraulic work, compressed air, ammonia, and rods of rectangular or circular section for reinforced concrete and other purposes may be joined in place without the use of machinery, furnace, electric power or hammering. The process is not applicable for tubes more than 6 inches in diameter.

VISES.—Catalog No. 7. Emmert Mfg. Co., Waynesboro, Pa. Describes and illustrates the patent universal and standard vises manufactured by this company. These include not only vises for woodworkers and patternmakers, but those for use by machinists, toolmakers and iron workers as well.

MOLDING MACHINES.—The Arcade Mfg. Co., Freeport, Ill. Twenty-eight page catalog. The Modern molding machine which is designed to handle light castings made in flasks 14 x 22 inches, or less, is fully described and illustrated. The patterns used on this machine are in the form of match plates or split patterns, the cope and drag valves of the mold being made at the same time. A four page pamphlet has also been issued by this company, describing its No. 2 machine, on which flasks may be used having dimensions up to 12 x 30 inches, or 16 x 24 inches, if placed side by side. The range of work on this machine is large, being used successfully for making castings weighing 75 pounds.

GRINDERS.—Ransom Mfg. Co., Oshkosh, Wis. Three catalogs, two of which illustrate and describe the motor driven grinders made by this concern, belt driven emery wheels and polishing machinery, while the third is devoted to a description of disc grinders.

PNEUMATIC TOOLS.—The Chicago Pneumatic Tool Co., Chicago. Catalog No. 24. Contains 100 pages. Devoted to a description of this company's line of pneumatic tools and appliances, including Boyer and Keller hammers, "Little Giant" drills, sand rammers, and hoists. This book is printed in colors, conveniently indexed and well bound.

ELECTRIC PYROMETERS. — Wm. H. Bristol, New York. Catalog No. 17, 40 pages. This work is devoted to a description of electric pyrometers of both the indicating and recording types as made for either switchboard or portable service. The thermo-electric couple for the instantaneous measurement of the temperature of molten metals as described in the August issue of THE FOUNDRY is also shown. The method of applying these electric pyrometers to hardening and annealing furnaces is explained and illustrated and a partial list of users, including many foundries and malleable iron works, is also given.

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British Foundrymen's Association

Although organized only four years, the British Foundrymen's Association now has a total membership of nearly 250, and the interest manifested in the annual meeting held at Sheffield, early in August, foreshadows growth more rapid than at any time in the history of the association. Branches have been organized in a number of large iron centers, monthly meetings being held for the discussion of topics vital to the foundry trade. Many valuable contributions to foundry literature have been made by these locals and the parent body and, working along lines similar to those of the American Foundrymen's Association, rapid advances, unparalleled by any past achievements, can be anticipated. The papers read and discussed at the Sheffield convention indicate that the British makers of castings are confronted with the same problems that are daily offered for solution to their American cousins. The purchase of iron by analysis is probably not so general abroad as in this country, but this is due largely to the attitude of the furnace operators who prefer to market their product by brands and fracture, and only reluctantly furnish analyses, even when demanded. A similar condition prevailed in this country not many years ago, but the refusal of foundrymen to purchase by fracture led to the general adoption of a more scientific basis. In his annual address, President Herbert Pilkington directed attention to the lax methods of cost keeping in British foundries. This applies with equal force to the iron melters of this country, and the adoption of a standard, which would guide the manufacturers, would ultimately lead to the elimination of ruinous competition in all branches of the trade. The jobbing founders of the United States now have a separate organization for the purpose of effecting a change in cost keeping methods, and committees should be appointed by both American and British bodies to consider the subject in the steel, malleable and brass lines. Three days were devoted to the Sheffield gathering, which in every way surpassed the previous meetings of the British organization. Ample time was allotted for the discussion of papers, notwithstanding the elaborate entertainment program provided. An address on "Ferro-Alloys," by E. Houghton, is by far the most comprehensive and important contribution yet offered on this subject. The treatment of iron with these elements is explained, and the analyses of the different grades given should form a valuable guide to the foundryman in making purchases.

Pig Iron Production

As compared with the first six months of 1906 the pig iron production of the first half of this year shows an increase of nearly 900,000 tons, the output of the furnaces having reached a total of 13,478,044 tons against 12,582,250 tons last year. This is at the rate of 27,000,000 tons annually, which from present indications will undoubtedly be reached by the end of the year. The charcoal pig iron production showed a slight falling off, the output having amounted to 205,796 tons, as compared with 207,722 tons during the first half of 1906. The production of basic iron showed a big gain, having been increased from 2,449,275 tons to 2,671,136 tons.

Trade Outlook

For the first time in more than two years real serious doubts are entertained as to the future of the iron trade. Beginning with the marked revival late in 1904 from the depression which began in the latter part of 1903, the iron trade has experienced a period of prosperity never before equaled. Early in this period doubts were expressed as to the genuineness of the movement, but these were soon dispelled. At no time in 1905 was there a question as to the future, and last year there was hesitancy for only a brief period during the second quarter, when several pig iron producers sold into the future as low as $13 Birmingham. This, however, did not constitute a depression, even of the mildest nature. The situation now is radically different. For two months all iron markets have been very quiet, notwithstanding the activity of the foundry trade. The contrast with the corresponding period of last year is most marked. In July, 1906, there was a heavy buying movement in foundry pig iron, with advancing prices, while in August steel making iron took the upward swing resulting in heavy sales. Years ago the iron market was always dull in the summer, but in late years this rule has been broken. The iron business has largely absolved itself from the influence of season, consumption and demand being more steady throughout the year, therefore a midsummer dullness attracts more notice than in

times past. In some quarters there has been a disposition to attribute the lessened demand to the large increases in productive capacity which are being made at this time. Not only is this true in the pig iron trade, but the foundry industry as well. Naturally, if capacity is being increased at a time when no increase is necessary, lower prices should ensue, but this erection has not been undertaken blindly. The idea was to serve the future rather than the immediate present. The present new erection may be a trifle ahead of the actual needs, but the market is in strong hands and the period can be tided over. In the Cincinnati market the appearance of some resale iron has had a rather demoralizing effect and the prices in that district have declined to $19 for spot shipments. In the east there is also a wide range of quotations, and in general it may be stated that prices are to a large extent nominal, as it is impossible to tell what would be the result if large buyers were to appear in the market. Iron foundries, on the other hand, with few exceptions are crowded with orders and are constantly urging deliveries. The steel foundries likewise have considerable future business on their books, while brass foundries are unable to make prompt deliveries, owing both to their inability to secure new metal and the congestion of orders.

PERSONAL.

Geo. H. Seltzer, formerly sales manager for Stanley G. Flagg & Co., Philadelphia, and lately with the Enterprise Foundry Co., Garwood, N. J., has taken the position of general manager of the Armstrong Iron Works, manufacturer of small and large gray iron castings, Vineland, N. J.

A. S. Blanchard, manager of the steel casting department of the Wellman-Seaver-Morgan Co., Cleveland, resigned July 1, to accept the position of assistant to the president of the Atha Steel Casting Co., Newark, N. J.

William T. Shepard, of the firm of Rogers, Brown & Co., has been elected a director of the Buffalo & Susquehanna Iron Co., to fill the vacancy on the board which was caused by the death of Frank H. Goodyear. Stephen M. Clement was elected first vice president, a position which was also held by the late Mr. Goodyear. Charles W. Goodyear was elected second vice president. William A. Rogers, president; Hugh Kennedy, general manager; H. D. Carson, secretary and treasurer, were again elected to their respective places.

E. W. Cadwell, a well known foundryman of Cincinnati, has been appointed superintendent of the plant of the Sneed & Co. Iron Works, Jersey City, N. J.

David Spence, manager of the L. F. Fales foundry, has resigned. His address is Franklin, Mass.

J. Cecil Nuckols, for the past three years advertising manager of the S. Obermayer Co., Cincinnati, Chicago and Pittsburg, has recently received the additional appointment of advertising manager of the Cincinnati Electrical Tool Co., Cincinnati.

H. P. Ranney, for a number of years superintendent of the foundry and pattern departments of the American Ship Building Co., Cleveland, has resigned, and will give his entire attention to the Bettcher Mfg. Co. Cleveland, of which he is president and treasurer. Mr. Ranney has been in the employ of the American Ship Building Co., since 1890.

H. A. Thomas, assistant superintendent of the foundry of the Foster-Waterbury Co., Franklin Park, Ill., has resigned his position, effective Sept. 1.

C. R. McGahey, Cedartown, Ga., has been appointed foundry engineer for the McWane Pipe Works, operating at Lynchburg and Radford, Va. Mr. McGahey will enter upon his new duties on September 1.

E. Killing, of the Killing Molding Machine Co., Davenport, Ia., has left for a short trip to Europe.

Prof. Charles H. Benjamin, who formerly occupied the chair of Mechanical Engineering at the Case School of Applied Science, Cleveland, has been appointed dean of the Schools of Engineering, Purdue University, to succeed Dean W. F. M. Goss, who resigned to accept a similar appointment at the University of Illinois.

Joseph Sosey has resigned as foreman of the foundry department of the Bellefontaine Foundry & Machine Co., Bellefontaine, O., and Charles A. Chapman is filling the position temporarily.

OBITUARY.

R. A. Culter, president of the Culter & Proctor Stove Co., Peoria, Ill., died at his home in that city on July 26. Deceased had been engaged in the manufacture of stoves for many years and his demise removes one of the country's most progressive stove foundrymen.

W. S. Withers, president and founder of the Withers Foundry & Machine Works, Atlanta, Ga., and a pioneer business man of that city, died July 31, at the residence of his son in Oakland City. He was born in South Wales 74 years ago and after receiving his education in England, came to the United States at the age of 19. Three years later he located in Atlanta, where his training as a founder and machinist quickly gained for him a remunerative position which later led to the establishment of the Withers Foundry & Machine Works. Ill health and advancing years later caused him to give up business cares and the foundry plant is now being managed by his son.

CANADIAN TARIFF REGULATIONS FOR A. F. A. EXHIBITORS.

The entertainment of the members of the American Foundrymen's Association, providing the convention is held in Toronto, Canada, in 1908, will be in charge of the Foundrymen's section of the Toronto Employers' Association. As the place of holding this meeting has, however, not yet been definitely decided upon, nothing has yet been done by this body in the way of preparation. The selection of the next meeting place is in the hands of the executive committee of the American Foundrymen's Association, and it is probable that Toronto will be definitely decided upon at an early date.

No difficulty will be experienced by the exhibitors in the shipment of goods into Canada or their return, as the Canadian National Exhibition, Toronto, has made arrangements with the Canadian customs department for the admission of exhibits from the United States free of duty, provided they are returned through the port of entry. When shipping, exhibitors are required to obtain an export certificate. There is a customs office in the exhibition grounds where arrangements can be made for delivery. Duty is, however, charged on all advertising matter taken into Canada in connection with exhibits.

PRODUCTION OF COPPER, SPELTER AND LEAD.

The copper production in the United States during 1906 reached a total of 906,591,947 pounds. This is an increase of about 18,000,000 pounds, or 2 per cent over the production of 1905, the total refined copper output being 882,568,237 pounds. The total spelter production in tons of 2,000 pounds was 224,770 tons. This is an increase over 1905 of 20,921 tons, or 10.3 per cent. The total production of refined lead was 404,669 tons.

GENERAL INDUSTRIAL NOTES

The extensive plant of the Seattle Car Mfg. Co., at Renton, a manufacturing suburb of Seattle, Wash., is now ready for operation. It includes a foundry, 75 x 80 feet; blacksmith shop, 75 x 80 feet; machine shop, 100 x 250 feet; erecting shop, 100 x 250 feet, and several other buildings.

The Champion Machinery Co., Joliet, Ill., has completed its new foundry, which has been under construction for several months. The building is of reinforced concrete, 60 x 66 feet, and is equipped with a 48-inch cupola with motor driven fans. It is designed to be fireproof.

The L. F. Fales Foundry is to be moved from Franklin, Mass., to Walpole, Mass., where Mr. Fales has a large machine shop.

The Best Steel Castings Co., Ltd., which is erecting a 30-ton steel foundry at Montreal, Can., has received its letters patent from the Canadian government. Some delay in the construction of the plant has been occasioned by a strike, but the Dominion Bridge Co. of Montreal, which has the contract for this work, is pushing the project night and day and it is expected that castings will be made by October 1. The company has ample business in sight. Carr & Speer, 120 Liberty street, New York, are consulting engineers for the plant.

The Youngstown Foundry & Machine Co., Youngstown, O., has elected the following officers: W. J. Wallis, president, succeeding Thomas Parrock; B. G. Parker, secretary, and Frank A. Williams, treasurer. The new board of directors is composed of A. E. Adams, S. K. Hine, E. Hartzell, W. J. Wallis, F. Andres, F. A. Williams and Thomas Parrock.

The West Side Foundry Co., Troy, N. Y., has been incorporated with a capital of $100,000, and will continue the gray iron foundry business of the old company of the same name. The company has two foundries and has lately increased its capacity by adding a 72-inch cupola and making other improvements. Wm. N. Sleicher is president; Charles A. Sleicher, vice president, and R. A. Stephens, secretary.

The new foundry of the American Foundry & Casting Co., Dayton, O., has been placed in operation.

The Lorain Castings Co., Lorain, O., which was recently incorporated, has its plant well under way and it is expected that it will be ready for operation early in September. E. M. Pierce is president.

The Leader Foundry Co., Quincy, Ill., has purchased the old foundry, formerly operated by the Reliable Foundry & Machine Co., and will do a general jobbing business in light and heavy gray iron castings.

The Waterman Car Wheel Foundry Co., Houston, Tex., has increased its capital stock from $75,000 to $100,000. It has added a second Newton cupola to its equipment, which now consists of one cupola of 5 tons and one of 10 tons hourly capacity, both furnished by the Northern Engineering Works, Detroit.

The South Side Steel & Malleable Castings Co., Milwaukee, has completed the erection of an extensive addition to its plant. The buildings consist of a foundry structure 76 x 260 feet, and a shipping and storage building 60 x 80 feet. A new melting furnace and annealing oven will be installed in the foundry department.

The Peavey Foundry Co., Inc., Lowell, Mass., has been organized with a capital of $40,000. The officers of the company are: President, Franklin S. Peavey; treasurer, James A. Peavey; clerk, Julia T. Peavey.

The Bellevue Pipe & Foundry Co., Bellevue, O., has increased its capital stock from $60,000 to $80,000.

The Browning Foundry Co., Ravenna, O., recently incorporated with a capital of $150,000, has taken over the foundry building and grounds formerly owned by the American Foundry & Machine Co., and has succeeded V. R. & E. H. Browning in the operation of the plant. Practically all the present product is used by the Browning Engineering Co., Cleveland. The officers of the new company are: V. R. Browning, president; E. H. Browning, secretary; Frank Root, treasurer; B. F. Miles, V. R. and E. H. Browning, Robert Keppie and W. H. Marsh, directors.

The Flour City Ornamental Iron Works, Minneapolis, has awarded a contract for the erection of a brick and steel foundry building 75 x 200 feet. The entire cost of the plant will be approximately $25,000.

New Construction.

James McGloughlin, proprietor of the Belknap Iron Foundry, Laconia, N. H., will build a new foundry to take care of his increasing business in knitting machine castings.

The Wetherill Finished Casting Co., Philadelphia, has let the contract for a machine shop and foundry, 85 x 125 feet, at the corner of Richmond street and Erie avenue. A two-story office building 38 x 62 feet will also be erected, the entire plant being of brick construction.

The Lake Shore Engine Works, Marquette, Mich., is erecting a new plant which will include the following buildings: machine shop, 80 x 240 feet; foundry, 80 x 160 feet; smith shop, 40 x 130 feet; pattern shop, 40 x 60 feet; pattern storage building, 32 x 100 feet; power house, 32 x 60 feet, and an office building. The company will expend about $100,000 in the construction and equipment of its new plant, and expects to have it in operation before winter.

The Clarksburg Foundry & Casting Co., Clarksburg, W. Va., recently organized with a capital of $10,000, will erect a plant in that city for the manufacture of gray iron and brass castings. The officers of the company are: E. T. Weir, president; W. B. Osborn, vice president; Virgil L. Highland, secretary and treasurer, and C. G. Jewett, general manager.

At the annual meeting of the stockholders of the Sharon Foundry Co., it was announced that a new open-hearth furnace would soon be installed and other improvements made to the company's plant at Wheatland, Pa. W. W. Shilling was made president and Thomas Kennedy was named as superintendent, secretary and treasurer.

The Menefee Foundry Co., Fort Wayne, Ind., manufacturer of brass and gray iron castings, is erecting an addition to its foundry, which will be used exclusively for molding.

The Lunkenheimer Co., Cincinnati, has been granted a municipal permit for the erection of a five-story concrete foundry building, which is to cost $25,000.

W. H. Sawyer & Sons, Americus, Ga., manufacturers of Sawyer-Fulford revolving scales and sacking machines, will erect a foundry, 70 x 90 feet, for the manufacture of the castings required in the production of their machinery. A 36-inch cupola will be installed and in view of the fact that the sections will be small, no cranes will be used. The entire equipment will be purchased locally.

The Ironton Malleable Co., Ironton, O., has purchased practically all of the material and equipment required for the erection of its plant, the core room and power house now being completed. The main foundry building will be completed approximately October 1, and castings will be made in November. For the present a general jobbing business will be conducted, although the firm is seeking good specialties. The active head of the company is J. M. Barringer, vice president and general manager, until recently general manager of the Zanesville Co.

The Alabama Pipe & Casting Co., Anniston, Ala., is building a foundry, 50 x 100 feet, for pipe casting and general foundry work. The machinery required has already been purchased. J. M. Stillwell, of Birmingham, will be manager.

James Lacy Co., Baltimore, Md., are erecting an addition, 16 x 87 feet, to their iron foundry. The building will be of brick and the cost is estimated at $3,000.

The Wetherill Finished Castings Co., Philadelphia, is erecting a one-story brick machine shop and foundry, 85 x 126 feet, and two-story brick office building, at Richmond street and Erie avenue. The buildings will cost about $24,000.

Brass Works.

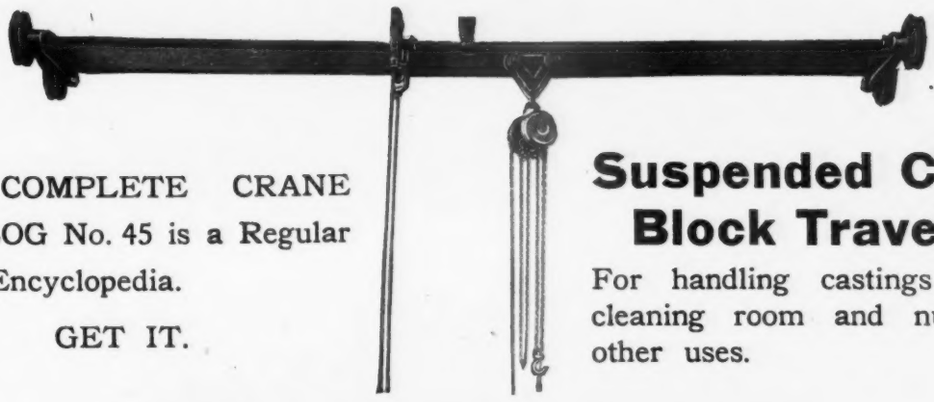
The Engineers' Supplies & Brass Foundry Co., South Bend, Ind., has filed articles of incorporation with a capital of $25,000. The directors are: C. T. White, E. P. Baum, S. A. Knobleck, E. J. Clark, and C. M. Kriegh-baum.

A. Gilbert & Sons, brass foundrymen, St. Louis, have acquired a site on Forest Park boulevard in that city, and are preparing plans for a new plant for the manufacture of railroad brasses, bronze and aluminum castings, babbit metal, etc.

The Falcon Bronze Co., Youngstown, O., is building a one-story brick addition to its foundry, 20 x 47 feet, in which it will install two double chamber furnaces furnished by the Rockwell Engineering Co. An oil tank for storage purposes in connection with the furnaces will also be added. The additional space and equipment will increase the capacity of the foundry about one-third.

The Joplin Brass & Metal Co., Joplin, Mo., has been formed with a capital of $30,000 by William G. Sergeant, Joseph Schneider, Jesse C. Owen, Blanche Sergeant and Chas. Moore. The company will manufacture all kinds of brass goods, but special attention will be paid to mining machinery.

The Rickersburg Brass Co., Cleveland, has been incorporated with a capital of $50,000, by Emanuel, David L., Solomon and Sidney Rickersburg and Joseph J. Klein. The company will establish a brass foundry for the manufacture of plumbers' supplies.



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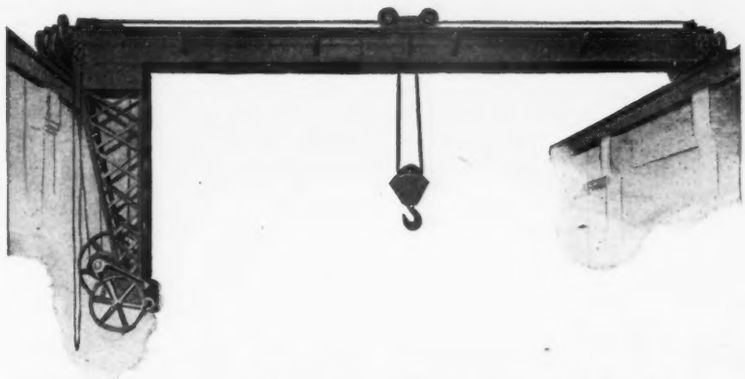

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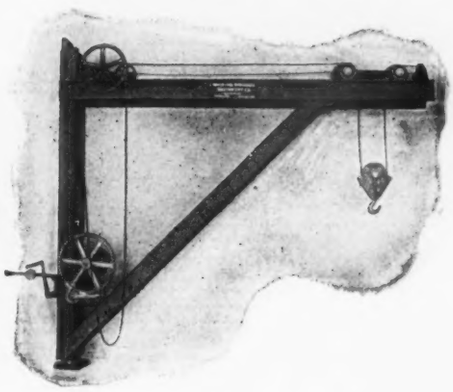

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46 to 13

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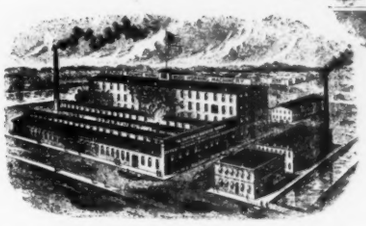

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Faithfully yours,

The Defiance Machine Works.

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Obermayer, S. Co., Cincinnati.
Pangborn, Thos. W. Co., New York.
Sly, W. W. Mfg. Co., Cleveland.
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Shanafelt Mfg. Co., Canton, O.
Smith, J. D., Foundry Supply Co., Cleveland.
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Taylor, A. L., San Francisco.
Taylor, Robert J., Inc., Philadelphia.
Whitehead Bros. Co., Providence, R. I.

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Curtis & Co. Mfg. Co., St. Louis.
General Pneumatic Tool Co., Montour Falls, N. Y.
Harrington, Edwin, Son & Co., Philadelphia.
Hobbs, Clinton, E. Boston.
Niles-Bement-Pond Co., New York.
Northern Engrng. Works, Detroit.
Pawling & Harnischfeger, Milwaukee.
Sellers, William, & Co., Inc., Philadelphia.
Whiting Fdy. Equipment Co., Harvey, Ill.
Yale & Towne Mfg. Co., New York.

Hoists (Electric):
Northern Engrng. Works, Detroit.
Yale & Towne Mfg. Co., New York.

Hoists (Hand):
Yale & Towne Mfg. Co., New York.
Northern Engrng. Works, Detroit.

Hoists (Pneumatic):
Chicago Pneumatic Tool Co., Chicago.
Ridgway, Craig, & Son, Coatesville, Pa.

Industrial Ry. Equipment.
Atlas Car & Mfg. Co., Cleveland.
Wonham & Magor, New York.

Iron Ore:
Rogers, Brown & Co., Cincinnati.

Ladles:
Northern Engrng. Works, Detroit.
Smith, J. D., Foundry Supply Co., Cleveland.

Lead:
U. S. Graphite Co., The, Saginaw.

Lumber (Pattern, Flask, etc.):
Lake Shore Saw Mill & Lumber Co., Cleveland.
Thompson, Lewis & Co., Inc., Philadelphia.

Magnets (Lifting):
Electric Controller & Supply Co., Cleveland.

Molding Machines:
Adams Co., Dubuque, Ia.
Arcade Manufacturing Co., Freeport, Ill.
Berkshire Mfg. Co., Cleveland.
Griffiths Mfg. Co., Beloit, Wis.
Herman Pneumatic Machine Co., Zelienople, Pa.
Killing Molding Machine Co., Davenport, Ia.
Manning, Maxwell & Moore, New York.
Maywood Foundry & Machine Co., New York.
Mitchell-Parks Mfg. Co., St. Louis.
Mumford, E. H. Co., Philadelphia.
New England Eng. & Equipment Co., Boston.
Paxson, J. W. Co., Philadelphia.
Pridmore, Henry E., Chicago.
Rathbone, John A., Detroit.
Smith, J. D., Foundry Supply Co., Cleveland.
Tabor Mfg. Co., Philadelphia.

Packing (Rubber Sheet):
Smooth-On Mfg. Co., Jersey City.

Parting Compounds:
Doggett, Stanley, New York.
Foundry Specialty Co., Cincinnati.
Partamol Co., New York.
Smyth, Swoboda & Co., New York.

Pattern Letters:
Shanafelt Mfg. Co., Canton, O.

Pattern Makers' Supplies:
Cleveland Fillet Co., Cleveland.

Patterns (Metal and Wood):
Herman Pneumatic Machine Co., Zelienople, Pa.

Pattern Shop Equipment:
Fox Machine Co., Grand Rapids, Mich.

Phosphorizers:
McCullough-Dalzell Crucible Co., Pittsburg.
New Era Mfg. Co., Kalamazoo.

Pig Iron:
Addy, Mathew, & Co., Cincinnati.
Bartlett, N. S. & Co., Boston.
Columbus Iron & Steel Co., Columbus.
DeCamp Bros. & Yule, St. Louis.
Domhoff & Joyce Co., Cincinnati.
Elliott, Debevoise & Anderson, New York.
Field, Robt., Sales Agency, Cincinnati.
Goodrich, F. A., & Co., Detroit.
Hillman, J. H. & Son, Pittsburg.
McKeefrey & Co., Leetonia, O.
Mohr, J. J., Philadelphia.
Nash, Isham & Co., New York.
Pickands, Brown & Co., Chicago.
Pickands, Mather & Co., Cleveland.
Pilling & Crane, Philadelphia.
Rogers, Brown & Co., Cincinnati.
Shepard, Chas. G., Buffalo.
Stevens, F. B., Detroit.

The Cost of It

The expense of a modern system of cost-keeping need be no greater than a crude, antiquated and inefficient way of keeping accounts.

Such a system is accurate, quick and in ample detail, and it gives the detailed costs of every part of the work while the business is fresh---when it is most valuable as a basis of comparison.

We have studied cost-keeping very carefully and have installed systems which meet these requirements in many well-known foundries.

Will you accord us an interview?

GUNN, RICHARDS & COMPANY

Production Engineers and Public Accountants . . . .

43 Wall Street, 43 Exchange Place, } NEW YORK — 50 Congress Street, BOSTON

First National Bank Building, CHICAGO, ILL.

224 St. James Street, MONTREAL

Thomas Furnace Co., Milwaukee.
United Iron & Steel Co., Pittsburg.
Walter-Wallingford & Co., Cincinnati and Pittsburg.

Plumbago:

Dixon Crucible Co., Jos., Jersey City.
Gautier, J. H., & Co., Jersey City.
Hill & Griffith Co., Cincinnati.
McCormick Co., J. S., Pittsburg.
McCullough-Dalzell Crucible Co., Pittsburg.
Obermayer, S. Co., Cincinnati.
Pettinos Bros., Bethlehem, Pa.
Ross-Tacony Crucible Co., Philadelphia.
Smith, J. D., Foundry Supply Co., Cleveland.
Stevens, F. B., Detroit.
United States Graphite Co., Saginaw.

Polishers' and Planers' Supplies:

Stevens, F. B., Detroit.

Preservatives:

Steel Preservation Co., Buffalo.

Refractories:

Western Foundry Supply Co., E. St. Louis, Ill. and New York City.

Riddles:

Adams Co., Dubuque, Ia.

Sand:

Pangborn, Thos. W. Co., New York.
Paxson, J. W. Co., Philadelphia.
Standard Sand & Machine Co., Cleveland.
Stevens, F. B., Detroit.
Waldie & McCauley Sand Co., The, New York.
Whitehead Bros. Co., Providence, R. I.

Sand Blast Machinery:

Drucklieb, C., New York.
Pangborn, Thos. W. Co., New York.
Paxson, J. W. Co., Philadelphia.
Steel Preservation Co., Buffalo.
Tilghman-Brooksbank Sand Blast Co., Philadelphia.

Sand Mixing Machinery:

Falls Rivet & Machine Co., Cuyahoga Falls, O.
Mumford, E. H., Philadelphia.
Pangborn, Thos. W. Co., New York.
Sellers, William & Co., Inc., Philadelphia.
Standard Sand & Machine Co., Cleveland.

Sand Sifters:

Chicago Pneumatic Tool Co., Chicago.
Deane Steam Pump Co., Holyoke, Mass.
Hanna Engrng. Works, Chicago.
Herman Pneumatic Machine Co., Zelienople, Pa.
Killing Molding Machine Co., Davenport, Ia.
Turner Machine Co., Philadelphia.
Standard Sand & Machine Co., Cleveland.
U. S. Chaplet Supply Co., New York.

Saws (Cold Cutting):

Tabor Mfg. Co., Philadelphia.

Seacoal:

Hill & Griffith Co., Cincinnati.
Obermayer, S. Co., Cincinnati.
Paxson, J. W. Co., Philadelphia.

Separators (Magnetic):

Dings Electro Magnetic Sep. Co., Milwaukee.
Elm City Engineering Co., New Haven.
Pangborn, Thos. W. Co., New York.

Shafting (Flexible):

Stow Mfg. Co., Binghamton, N. Y.

Shapers:

Morton Mfg. Co., Muskegon Heights, Mich.

Shovels:

Stevens, F. B., Detroit.

Sprue Cutters:

Barnett, Oscar, Fdy. Co., Newark.
Shuster, F. B., Co., New Haven.
Middleditch, Benj., Detroit.
Turner Machine Co., Philadelphia.

Stones (Oil, Rubbing, Sharpening):

Norton Company, Worcester, Mass.

Stoppers:

McCullough-Dalzell Crucible Co., Pittsburg.
Ross-Tacony Crucible Co., Philadelphia.
Taylor, Robert J., Inc., Philadelphia.

Stove Trimmings:

Burdick & Son, Albany, N. Y.

Testing Machines:

Keep, W. J., Detroit.

Thermit Process:

Goldschmidt Thermit Co., New York.

Tools (Molders'):

Dobson, William, Canastota, N. Y.
Obermayer, S. Co., Cincinnati.
Paxson, J. W. Co., Philadelphia.
Smith, J. D., Foundry Supply Co., Cleveland.

Tools (Pneumatic):

Chicago Pneumatic Tool Co., Chicago.
Independent Pneumatic Tool Co., Chicago and New York.

Trolleys:

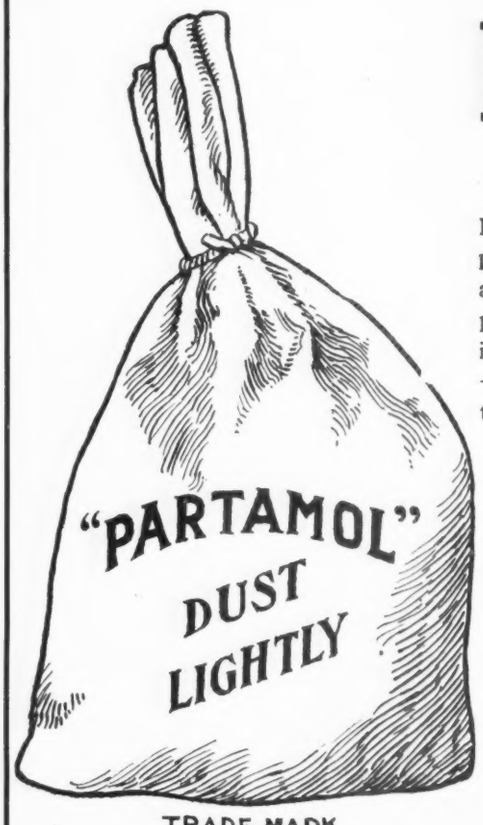
General Pneumatic Tool Co., Montour Falls, N. Y.

Tumbling Mills:

Adams Co., Dubuque, Ia.
Falls Rivet & Mch. Co., Cuyahoga Falls, O.
Gilmour, J., New York.
Sly, W. W., Mfg. Co., Cleveland.
Smith, J. D., Foundry Supply Co., Cleveland.

Wire Straighteners:

Blake, Geo. F., Mfg. Co., New York City.
Shuster, F. B. Co., New Haven.



TRADE MARK

PARTAMOL

The Standard "Never Stick" Parting

Prevents the sand sticking to the pattern; producing a sharp, clean, perfect mold with every line, shape and conformation truly delineated as in the pattern. These smooth, true-to-pattern castings please customers and save much cutting and trimming in the cleaning room. Not using means losing. Be wise with the wise ones—save with the saving ones and use "PARTAMOL." Send for a trial sample and convince yourselves.

Order from us or the following distributors:

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Detroit Foundry Supply Co., Detroit, Mich.
J. D. Smith Foundry Supply Co., Cleveland, Ohio
Frederic B. Stevens, Detroit, Mich.
Cutter, Wood & Stevens Co., Boston, Mass.
The Dominion Foundry Supply Co., Montreal, Canada
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THE PARTAMOL COMPANY

415 BROADWAY NEW YORK

Have you the facts?

If the original facts on which your costs are based are correct, and your plan for obtaining these facts is simple and accurate, you possess information which will unerringly locate the waste and weaknesses and ineffective methods in your plant.

Have you any idea how much such information would be worth to you? Are you aware that it is just as simple to know exact facts as to be satisfied with approximations?

We are specialists in those modern methods of foundry economy which have a vital bearing both on competition and profits.

We offer you the benefit of our experience with many of the leading foundries of the country.

We invite correspondence.

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316 Broadway, New York

CLASSIFIED ADVERTISEMENTS

Wanted and For Sale advertisements 40 cents a line. Positions and Help Wanted 25 cents a line. Count seven words to the line.

FOUNDRY FOREMAN WANTED

FOREMAN WANTED FOR SMALL CAST iron pipe foundry. Must be thoroughly competent and a good all-round man. State experience, age, and salary expected. Address Box 569, THE FOUNDRY, Cleveland, O.

FOUNDRY FOREMAN WANTED IN grey iron foundry of about fifty molders, making both heavy and light castings, located in Chicago. State age, experience and former employer, also salary expected. Address Box 573, THE FOUNDRY, Cleveland, O.

A TEMPERATE IRON FOUNDRY FOREman between 25 and 35 to learn to manage a small non-union Steel Foundry. Must have a broad experience in green and dry sand molding; good executive and energetic qualifications. A rare opportunity for the right man. Address particulars with reference to Box 598, THE FOUNDRY, Cleveland, O.

NON-UNION WORKING FOREMAN wanted for malleable iron foundry making small castings. Must understand mixing of irons and running cupola. Address Box 556, THE FOUNDRY, Cleveland, O.

FOUNDRY FOREMAN WANTED FOR small jobbing foundry employing 30 molders. One experienced with molding machines preferred. A good opportunity for the right man. Town of about 18,000 inhabitants. Address Box 582, THE FOUNDRY, Cleveland, O.

AN EXPERIENCED STEEL FOUNDRY foreman wanted under 40 to manage a non-union shop in Ohio. Must have good executive and pushing qualities and be temperate. Give age, experience and references. Address Box No. 37, Jamestown, Pa.

FOREMAN WANTED FOR A LARGE car wheel foundry, must be thoroughly posted in all details, strictly temperate, open shop man. This is a first class opening for a first class man with A1 references. Address Box 593, THE FOUNDRY, Cleveland, O.

FOUNDRY FOREMAN WANTED EXperienced on castings for ornamental iron work; non-union; shop located in Chicago. Only high grade man with first-class reference need apply. Address Box 576, THE FOUNDRY, Cleveland, O.

FIRST-CLASS FOUNDRY FOREMAN wanted; foundry working about 15 molders; open shop. Apply The Vulcan Iron Works, Seattle, Wash.

MOLDERS WANTED

A FEW FIRST CLASS FLOOR AND bench molders and two first class core makers wanted, medium and light castings, gray iron foundry. Union shop and standard wages. Our plant is located about 200 miles from Chicago in a healthful locality. Address Box 592, THE FOUNDRY, Cleveland, O.

WANTED FOR CENTRAL CALIFORNIA four iron molders, one brass molder, and one melter for gray iron cupolas. Engine and general work, nine hour day. None but first-class men need apply, such that can earn the best wages and hold a steady job. Men with families preferred. State whether union or non-union and give references. Address Box 559, THE FOUNDRY, Cleveland, O.

FIRST CLASS MOLDER WANTED with experience on medium weight high grade iron machinery castings. To the right man, if familiar with melting iron and with ability to handle men, a position of Assistant Foreman is open. To receive consideration give full details of experience; for whom you have worked, length of time, class of work, and wages received. All communications will be considered confidential. Address Box 568, THE FOUNDRY, Cleveland, O.

SALESMEN WANTED

SALESMAN WANTED calling on Iron and Brass foundries to sell Lycopart, a parting compound, as a side line. Liberal commissions paid. See our advertisement. Smyth, Swoboda & Company, 73 Warren Street, New York City.

FOUNDRY EQUIPMENT SALESMAN wanted. Must be a practical foundryman and familiar with molding machines. State age, experience, whether married or single, and salary expected. Address Box 595, THE FOUNDRY, Cleveland, Ohio.

HELP WANTED, MISCELLANEOUS

A FIRST CLASS SOLICITOR WANTED for job work for brass foundry. Must be thoroughly conversant and capable of making prices. Residing near vicinity preferred. Good opportunity for the right party. Answer with full details and references. Manufacturers at Cleveland, O. Address Box 587, THE FOUNDRY, Cleveland, O.

CUPOLA TENDER WANTED, CAPABLE of handling a cupola melting 75 to 100 tons daily on car wheels. Must be strictly temperate, married, and furnish A1 references. Address Box 594, THE FOUNDRY, Cleveland, Ohio.

COMPETENT FOREMEN OF BRASS finishing room wanted for concerns in Pennsylvania and Massachusetts; must be experienced, aggressive men familiar with all up-to-date methods; salaries, $1,200-$1,800. Hapgoods, 305 Broadway, New York.

SUPERINTENDENTS WANT POSITIONS

POSITION AS FOUNDRY SUPERINtendent wanted by a practical foundryman on heavy or light gray iron castings. Well experienced on molding machines. Will be open for an engagement Sept. 1st. Would like to secure a position with a good reliable company where I can prove my ability. A No. 1 reference. Address Box 585, THE FOUNDRY, Cleveland, O.

POSITION AS FOUNDRY SUPERINtendent wanted by man who is fully competent to take entire charge of foundry making light or medium weight castings. Address Box 586, THE FOUNDRY, Cleveland, O.

POSITION WANTED AS SUPERINTENDent or Assistant in Brass or Iron line, by a competent man, age 38, good executive ability and up-to-date. Can reduce cost of manufacture by special machinery or devices, can handle any department from Foundry up. Will consider only steady position. Address Box 575, THE FOUNDRY, Cleveland, O.

SITUATION WANTED AS ASSISTANT superintendent in malleable plant. Age 28, nine years' practical experience in mixing, melting and annealing. Good cost accountant, proficient in speeding help. Address Box 577, THE FOUNDRY, Cleveland, O.

SITUATION WANTED BY A CLEANcut aggressive foundryman with fifteen years' experience, thirty-nine years of age, married and strictly temperate in his habits, good executive ability, thoroughly experienced in all details in foundry practice and well qualified to accept a position as foreman or superintendent in a large gray iron foundry, making dry and green sand, heavy and light castings, or car wheels. Strictly an open shop man with first class references. Address Box 522, THE FOUNDRY, Cleveland, Ohio.

POSITION WANTED AS FOUNDRY superintendent by a first class foundryman, thoroughly familiar with every detail connected with foundry and pattern work; one competent to put one or more foundries on a systematic working basis. At present holding responsible position. Address Box 583, THE FOUNDRY, Cleveland, O.

MR. DAVID SPENCE, THE WELL known Foundry Manager and Superintendent, is open for engagement with reliable firms. Address David Spence, No. 9 Ray St., Franklin, Mass.

SUPERINTENDENCY OR FOREMANship wanted of gray iron foundry making heavy or light gray iron castings, by competent, experienced, practical man. Used to estimating, and producing first class work. First class references. Parties having struck shops do not answer. East preferred. Address Box 591, THE FOUNDRY, Cleveland, O.

POSITION AS FOUNDRY SUPERINtendent wanted in malleable or grey iron foundry. Have had full charge of one of the largest malleable foundries in the West, where gas and air furnaces were used. Am a good handler of men. Up-to-date in cupola practice and mixing of iron. A No. 1 reference. Address Box 584, THE FOUNDRY, Cleveland, O.

FOREMANSHIP WANTED

POSITION WANTED AS FOUNDRY foreman. Light and heavy work. Twenty years' experience. Good references. Address Box 562, THE FOUNDRY, Cleveland, O.

POSITION AS FOREMAN in a light gray iron shop wanted. Twenty-two years' experience as molder. Understand molding machines and cupola practice. Can furnish reference. Address Box 931, THE FOUNDRY, Cleveland, O.

FOUNDRY FOREMAN WOULD LIKE TO make a change. Have charge of a shop employing 30 molders; 20 years' experience in heavy, green, and dry sand work, 12 as foreman. Forty years old and strictly temperate. New England district preferred. Address Box 578, THE FOUNDRY, Cleveland, O.

POSITION WANTED AS FOREMAN by a first class brass foundryman with good executive ability on all kinds of work, up-to-date on core work of all kinds, moulding machines, oil furnaces, etc. Address Box 580, THE FOUNDRY, Cleveland, Ohio.

POSITION AS FOREMAN IN BRASS foundry wanted. Up-to-date, good mixer of metals, 18 years' experience with some of the largest works and every branch of the business. A1 references. Open Sept. Address Box 596, THE FOUNDRY, Cleveland, O.

ASSISTANT FOUNDRY FOREMAN would like to make a change. Well up in cupola practice, mixing iron, molding machines and modern methods. Address Box 579, THE FOUNDRY, Cleveland, O.

PATTERNSHOP HELP

POSITION WANTED AS FOREMAN BY a first class pattern maker, young, reliable and of good habits. Wide experience; references. Address Box 570, THE FOUNDRY, Cleveland, O.

CORE ROOM HELP

THOROUGHLY EXPERIENCED FORElady desires situation. Competent to start core-room work with green girls on any class of light or medium work. Speaks Polish; good record. Address Box 581, THE FOUN-

POSITIONS WANTED, MISCELLANEOUS

COST ACCOUNTANT—SPECIALIST IN foundry—now in charge of large department, desires change. Will install system or take permanent position or both. Present business—heavy machinery line. Address Box 590, THE FOUNDRY, Cleveland, O.

POSITION WANTED AS FOUNDRY AND machine shop Manager or Assistant. A-1 bookkeeper, cost accountant and estimator; 20 years' experience in plant employing over 500. Address Box 574, THE FOUNDRY, Cleveland, O.

POSITION WANTED AS MANAGER OR foundry foreman by young man with 16 years experience in gray iron. Can give best of references. Address Box 597, THE FOUNDRY, Cleveland, O.

FOUNDRY FOREMAN WISHES TO run large plant to good advantage. Non-union man, and best of references, foundry heavy work and coremaking, and capable to correspond with firms who want an up-to-date foreman strictly mechanical at all light and practice for 30 years. Address Box 545, THE FOUNDRY, Cleveland, O.

PROPERTY FOR SALE

A COMPLETE AND FULLY EQUIPPED foundry and machine shop for sale in southern California. Trade is well established and amounts from $3,000 to $5,000 per month. It is the only institution of its kind within a radius of forty miles and in the most prosperous and rapidly growing section of California. The business can be increased to almost any amount by the employment of the necessary capital. Owner desires to sell all or half interest on account of other interests demanding his attention. Riverside Foundry & Machine Works, Riverside, Cal.

A FINELY EQUIPPED GRAY IRON foundry for sale or lease for a term of years. Established business. Capacity 30,000 pounds per day. Two electric traveling cranes of 30 tons capacity. Compressed air. Two-cent electricity—7-cent gas. Located central Ohio. On two trunk lines. Address Box 533, THE FOUNDRY, Cleveland, Ohio.

FOUNDRY AND MACHINE SHOP FOR sale. Located in one of the most prosperous cities in the South—a great railway center. A bargain to the right party. Address Box 572, THE FOUNDRY, Cleveland, O.

MY JOBBING PATTERN BUSINESS AT Denver, Colo., for sale. An excellent opportunity for a first class practical man. Address J. L. Gard, 1616 Blake St., Denver, Colo.

MODERN, COMPLETELY EQUIPPED foundry and pattern shop for sale, now in operation. Molding floor 35′ x 80′; railroad track; electric power; room for expansion. Address Box 589, THE FOUNDRY, Cleveland, Ohio.

BUSINESS OPPORTUNITIES

BUSINESS OPPORTUNITY. A GRAY iron foundry with an established business and capacity of 750,000 pounds per month, fully equipped for heavy work, would take in an active partner desiring to buy an interest in the business. For details address Box 534, THE FOUNDRY, Cleveland, Ohio.

INVENTORS ATTENTION: MERITORious patented foundry machinery manufactured on royalty basis. Long experience and unexcelled facilities for reaching foundry trade. Whiting Foundry Equipment Company, Harvey (Chicago Suburb), Ill.

CUPOLAS, ETC., FOR SALE

TWO SECOND-HAND CUPOLAS IN first-class condition. Shells 72″-82″ in diameter and about 40 feet high. Box 800, THE FOUNDRY, Cleveland, O.

COLLIAU CUPOLA FOR SALE. Diameter of shell, 43 inches. Good condition. Immediate shipment. Address Haines, Jones & Cadbury, Inc., Norristown, Pa.

MOLDING MACHINES FOR SALE

1 Mumford air squeezer, 44″.
7 Farewell molding machines.
Practically all new. Write for information to A. Buch's Sons Co., Elizabethtown, Pa.

FOUR ARCADE MOLDING MACHINES for sale at a sacrifice. Acme Steel & Malleable Iron Works, Buffalo, N. Y.

FLUOR SPAR

FLUOR SPAR.—EVERY GRADE. QUOtations delivered anywhere. Cheapest suppliers. Address GEO. G. BLACKWELL SONS & CO., Ltd., Liverpool, Eng., or Agents, Penna. Salt Mfg. Co., Pittsburg, Pa.

FLUOR SPAR.—"ENGLISH." 45 TO 95 per cent fluor and 2 to 4 per cent silica—monthly arrivals. The British Mineral Co., represented by J. W. Paxson Co., Philadelphia, Pa.

FLUOR SPAR—BY THE BARREL, TON or car lots. Address American Fluor Spar Co., Paducah, Ky.

ENGINES FOR SALE

ONE 150-H. P. WETHERILL CORLISS engine in good condition, for sale. Address T. E. M., Room 1632 Commercial National Bank Bldg., Chicago, Ill.

FOR SALE, MISCELLANEOUS

CAST IRON TOY PATTERNS FOR sale, complete, up-to-date line, all gated and in excellent condition. Also few thousand dollars' worth of orders and sales included. Increase in other lines compels us to discontinue Toys. Address Box 548, THE FOUNDRY, Cleveland, O.

ONE BESSEMER CONVERTER FOR Sale, diameter 84″, total height, 153″, Complete. Two Cupolas, diameter 78″, heighth 43′, Complete. All in perfect condition having never been used. Address Room 1632 Commercial Nat'l. Bk. Bldg., Chicago, Ill.

WILL SELL REASONABLE, SET OF patterns for warm air furnace, together with patents. Splendid opportunity to increase your business. Correspondence invited. Address Box 588, THE FOUNDRY, Cleveland, O.

20 H. P. HEATING BOILER for sale, practically new; heating capacity 18,000 to 20,000 cubic feet. Western Malleable Steel Company, Detroit, Mich.

BLOWER BARGAINS.
Roots Second-Hand Blowers, bought, sold, or exchanged for new ones. Address,
H. M. PAPWORTH.
120-122 Liberty Street, New York City.

WORK WANTED

A WELL EQUIPPED MACHINE SHOP and foundry desires to add to its output by the manufacture of articles of brass and iron which would find a ready sale in the South. Correspondence invited. Address Box 544, THE FOUNDRY, Cleveland, O.

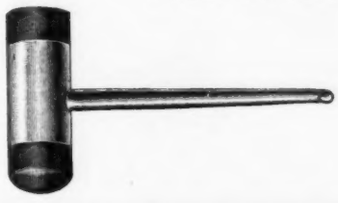
FOUNDRY EQUIPMENT WANTED

SECOND-HAND FOUNDRY EQUIPMENT wanted, including Cupolas, Ladles, Tumbling Barrels, etc. Quote price and state condition. Address Box 885, THE FOUNDRY, Cleveland, Ohio.

SECOND-HAND CRANE LADLE WANTed, 22, 25, or 30-ton. Must be in good condition. The Hooven, Owens, Rentschler Company, Hamilton, O.

A GOOD SECOND HAND CUPOLA wanted, 48 to 56 in. diameter (Colliau preferred). Also a good second hand pressure blower for same. Address with full particulars Box 554, THE FOUNDRY, Cleveland, O.

YOU NEED THIS TOO——



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DRAW HOOK and MALLET.

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From Cribben & Sexton Co. Chicago, Ill.:
"Send sample Draw Hook and Mallet. We are needing something of this kind and if sample proves to be the thing desired, will place order,"
A few days later.
"Enter our order for immediate shipment one gross of these."

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Maker of **MOLDERS' TOOLS**
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Lowest Cost. Greatest Efficiency
Immediate Shipments.

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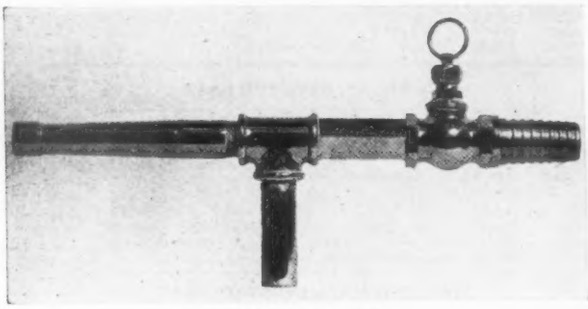
No Cumbersome Tanks!

A TRIAL Will Convince.



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SIMPLICITY; THOROUGHNESS; LOW COST.

80 to 90 pounds straight air pressure required.

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Use The Injector Sand Blast Apparatus

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ADAPTED TO HIGH OR LOW AIR PRESSURES.

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Detroit Foundry Supply Co., - - - - - Detroit, Mich.
Canadian Rand Co., - - Montreal and Toronto, Canada.

ESTABLISHED 1875.

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Take the Tool to the Work and Save Heavy Handling.

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ALUNDUM

Represent the Highest Efficiency and Uniformity in Grinding Wheels

If you have a Grinding Problem, we are specialists in this line and you can have the benefit of years of experience for simply the asking. New Booklet on ALUNDUM will interest you.

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Worcester, Mass.

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Agencies in all large cities of the world

Carborundum will cut every other known abrasive—

No other known abrasive will cut Carborundum—

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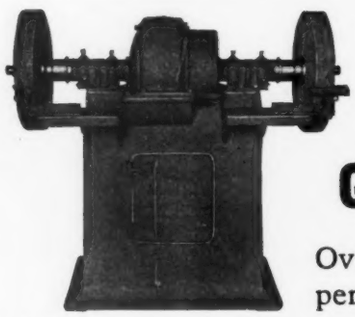

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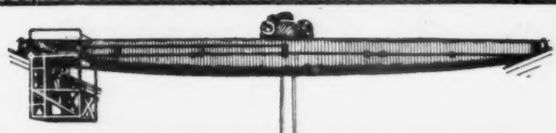

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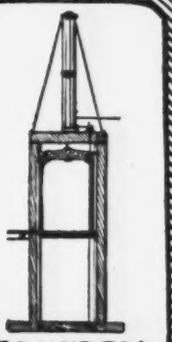

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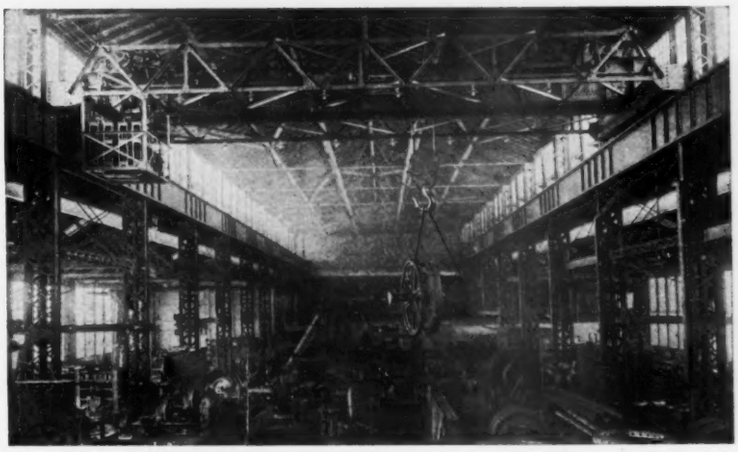

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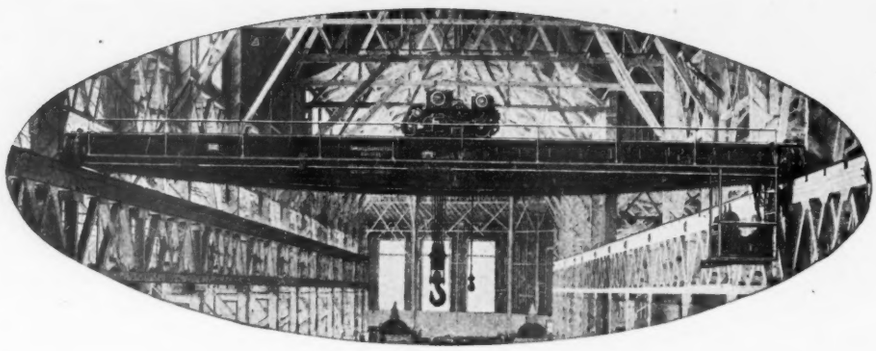

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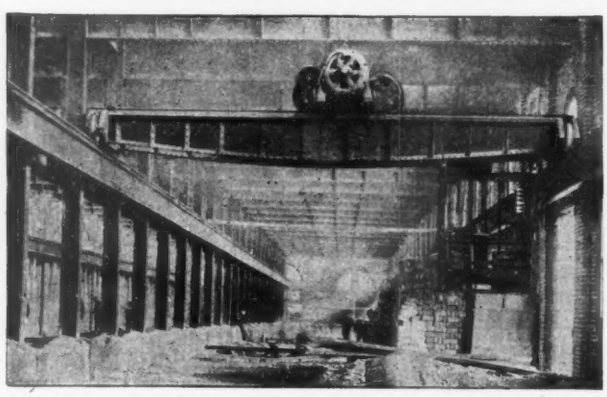

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